



SOLID STATE
HOW SINGAPORE
IS BUILDING FOR A
STRONGER FUTURE
REPORT P40

TEHRAN AHEAD

Airbus and ATR orders just the start, as Iran begins process of modernising its airline inventories **12**

SEASTAR SHINES

Chinese backers help Dornier Seawings to refloat production of unique amphibian **36**

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Celebration as 737 Max gets airborne –
but can Seattle close sales gap with Neo?



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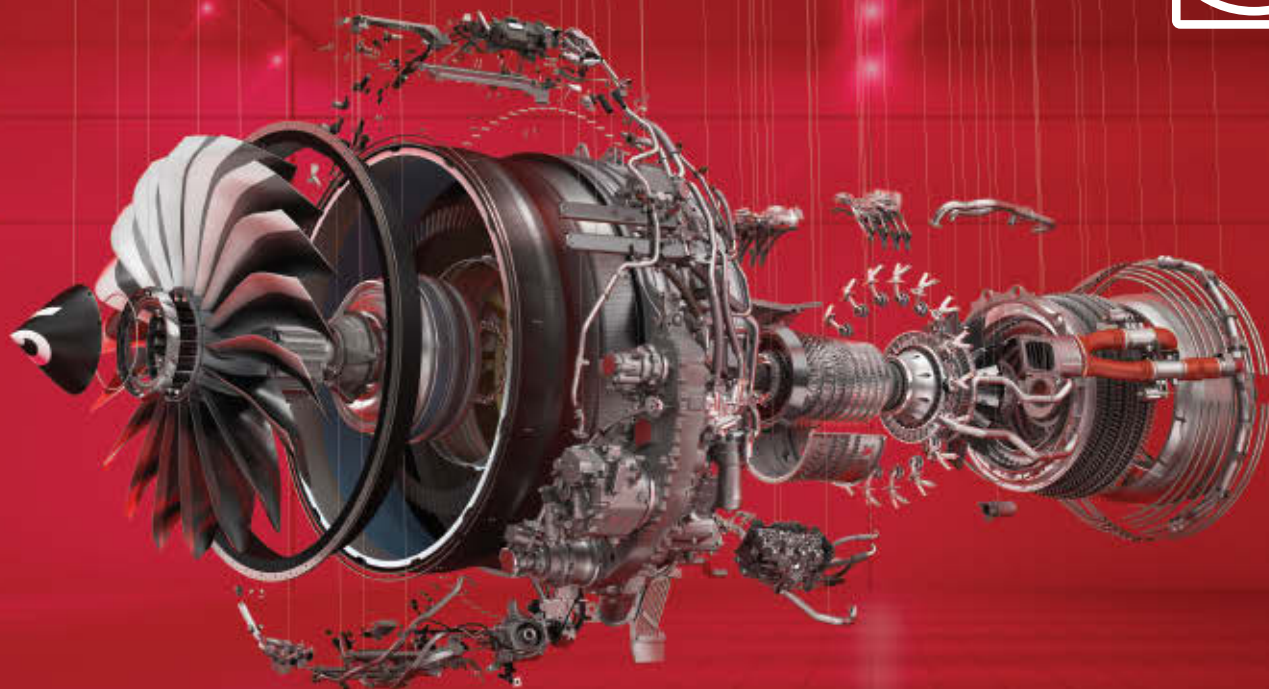
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COVER IMAGE

Boeing's lead 737 Max 8, the "Spirit of Renton", completed a 2h 47min first flight on 29 January. The company provided this shot of the new narrowbody **P16**



BEHIND THE HEADLINES

Greg Waldron (pictured) put down his Aviators to compile part of our special report in advance of the 16-21 February Singapore air show (P40). And James Drew was in Renton, Washington, to witness the historic first flight of the 737 Max (P16)



NEXT WEEK F-35 TRAINING

As the US Air Force draws closer to declaring the F-35 ready for service, we look at its growing training network

NEWS

THIS WEEK

- 10** US budget saves A-10 ground-attack aircraft as 'arsenal plane' emerges
- 11** Boeing coy over opportunity in middle market. F-35 testing could run on into 2018, report claims. G500 readied for flight envelope expansion work
- 12** Iran offers ambition, but little clarity
- 14** Virgin's 747 gains Cosmic makeover. Geared turbofan patent faces GE Aviation protest

AIR TRANSPORT

- 20** MRJ test flights to restart this month after modification. EasyJet hails the fuel-saving potential of hybrid taxiing system
- 23** Alcoa to supply 777X alloys. A340 damaged at Madagascar. New long-haul routes show airlines willing to go the distance
- 25** Taiwan's Aviation Safety Council slams TransAsia safety culture

DEFENCE

- 26** Fixed-wing trainer deal signed by UK. Meteor expects to have big impact on UAV market
- 28** 747-8 up to PAR as new Air Force One. HAL rolls out first prototype of indigenous HTT-40 basic trainer
- 30** Paris could speed up rotary renewal. Israel widens the field for unmanned systems requirement

NEWS FOCUS

- 32** Ensuring Singapore's defensive edge

BUSINESS AVIATION

- 36** Funding in place for Seastar relaunch. Comlux signs up for trio of Airbus ACJ320neos
- 38** Rise mulls European ascent. Jackie Chan uses Legacy 500 to beat Rush Hour. Global Jet Capital eyes growth in Latin America on back of GE deal



Singapore continues to enhance its combat fleet **P32**

COVER STORY

- 16** **737 Max takes a great Leap forward** First flight for re-engined narrowbody ushers in 18-month test period, as Boeing looks to catch A320neo

FEATURES

- 40** **SINGAPORE Sing the praises of aerospace** On the eve of the Singapore air show, we focus on the tiny city-state that packs a punch when it comes to aviation. Its air force, already arguably the most potent in Southeast Asia, is set for major upgrades. And, in a broader region where economies and civil air travel are booming, Singapore's Changi airport is a hub of huge significance, both for intra-Southeast Asian traffic and connections to Europe, Africa and the Middle East. Maintenance, too, figures increasingly in a growing aerospace industry

REGULARS

- 9** Comment
- 58** Straight & Level
- 60** Letters
- 62** Classified
- 64** Jobs
- 67** Working Week



GE petitions to revoke P&W's geared turbofan patent **P14**. US operator Rise evaluates European market **P38**



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IMAGE OF THE WEEK

On 29 January, Boeing and Swiss International Air Lines introduced the carrier's first 777-300ER, after the new widebody arrived in Zurich. The operator plans to start using the type – which it ordered to replace its existing Airbus A340s – on an inaugural revenue flight to New York on 21 February

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THE WEEK IN NUMBERS

↑ **100%**

Flightglobal dashboard

Revenue dipped, but Singapore Airlines doubled its third quarter operating profit to \$130m, due to falling fuel costs

\$37.2bn

Berkshire Hathaway

The value of Berkshire Hathaway's acquisition of Precision Castparts, announced in August and completed last week

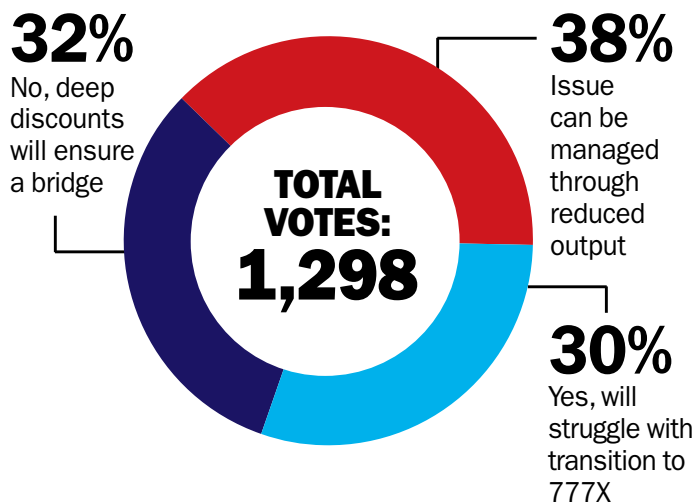
↑ **27**

EasyJet

Number of European bases for budget airline EasyJet, with the opening of facilities at Venice Marco Polo airport

QUESTION OF THE WEEK

Last week, we asked: **Is Boeing's 777 production rate cut a cause for concern?** You said:



This week, we ask: **Is Iran's planned aviation expansion**

- ☐ Great news for Airbus and Europe?
☐ Beneficial for entire aerospace industry? ☐ Unrealistic?

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What follows?

Having abandoned a clean-sheet design to replace its 737 in 2011, Boeing has moved swiftly towards flight testing a re-engined version. But its focus may now shift to something larger

Last month, the first new aircraft of Boeing's second century took flight from Renton, Washington. It is apt that the newest arrival is the fourth iteration of an old favourite: a re-engined 737 known as the Max.

In the wake of the maiden sortie Boeing executives were typically upbeat, with one predicting that if this was any indication of the following 99 years, it would be "an amazing century".

Boeing now has to focus on execution: it must test, certificate and deliver four different variants of the narrowbody in relatively short order.

But one unanswered question remains: what next?

Amid a record-breaking sales war between the 737 Max and Airbus A320neo, one could be forgiven for failing to look past the mountainous backlog of nearly 7,500 aircraft between the two narrowbodies.

However, the genesis of the Max may offer an insight to the airframer's future direction of travel.

Boeing must test, certificate and deliver four variants of the 737 Max in short order

In early 2011, then-Boeing Commercial Airplanes chief Jim Albaugh infamously wagered that it would shun a re-engining programme on the 737 in favour of an all-new single-aisle.

But thanks to Airbus's seizing the initiative with the Neo – and Boeing's still recent troubles with clean-sheet developments – what the world ended up with is precisely what Albaugh forecast it wouldn't.

Market forces appear to favour this incremental approach, as Boeing acknowledged in December 2011, when it ditched its clean-sheet design for the Max.



And now for our next number

Since then it has been playing catch-up with Airbus, which has already delivered its first Neo and has a seemingly unassailable 60% share of the market for re-engined narrowbodies.

But Boeing still has an opportunity to put its European rival on the back foot. There exists a space for an aircraft which crosses over between the very largest narrowbodies and smaller twin-aisles. Seattle calls this the "middle of the market", and has been coy about its plans for the segment.

If there is any room for a rupture in the competitive dynamics between the big two, then it is here. If Boeing gets it right, it has a chance to put Airbus on the defensive from the top to the bottom of the widebody sector.

Noises emanating from Seattle suggest it is considering both clean-sheet and derivative designs, the latter far quicker to market. But with an absence of mature but game-changing airframe or propulsion technology, this could be a devilishly tricky – and expensive – move to pull off. ■

See This Week P11, Cover Story P16

Iran's plans

Iran Air's former bureau in central London, opposite the Ritz Hotel, used to draw the attention of passers-by because its window display featured a large aircraft model unlike any other in the capital.

Shown in full Iran Air livery, the BAC-Aérospatiale Concorde was both striking and anachronistic – a symbol of pre-revolutionary Iranian opulence still being used to promote the Islamic republic's flag-carrier, over 30 years since it was blocked from purchasing Western jets.

Iran Air might have struggled to justify a Concorde acquisition on economic grounds. And now that the carrier is emerging from its time-capsule bubble, it is facing similar considerations over another flagship.

Somewhere in Tehran there might be a carefully-

crafted strategic plan balancing the intake of capacity against realistic demand. But if there is, Iran Air is keeping it to itself.

Intentions are unclear, and statements from officials suggest there is still plenty of vagueness over delivery schedules, or even whether it will convert the entire headline deal with Airbus into meaningful orders.

Modernising Iran's air transport system will take more than extravagant purchasing. The country surrendered its prominent position to the Gulf carriers – and catching up requires rational level-headedness, not a shopping-while-hungry mentality. Iran Air won't want more aircraft showing what might have been. ■

See This Week P12



Stay on top of the latest news and analysis of the commercial aviation sector, by going to: flightglobal.com/dashboard



BRIEFING

SUPERJUMBOS SET FOR ALL NIPPON AIRWAYS

FLEET All Nippon Airways (ANA) has confirmed that it is behind a previously undisclosed order for three Airbus A380s. To be operated on its Tokyo-Honolulu route, the aircraft are being acquired for around ¥150 billion (\$1.2 billion), and will be delivered during the 2018 and 2019 fiscal years. Rolls-Royce Trent 900 engines are to power the superjumbos. ANA Group plans to expand its total fleet to around 300 aircraft by the end of March 2021, from a current 258.

EGYPTIAN DEAL NEARS FOR SUPERJET

INTEREST Egyptian carrier Air Leisure could sign a lease-to-buy deal covering four Sukhoi Superjet regional airliners plus six options, says the Russian manufacturer's president Ilya Tarasenko. The two sides discussed terms for the potential transaction during a joint business forum in Cairo. Flightglobal's Fleets Analyzer database shows that Air Leisure has three in-service Airbus A340s.

CONVERSION GIVES ST AERO CONTROL AT EFW

OWNERSHIP ST Aerospace has increased its shareholding in Airbus Group's Dresden, Germany-based freighter conversion centre Elbe Flugzeugwerke (EFW) by 20%, to 55%. The acquisition is part of an agreement, disclosed at last year's Paris air show, related to the development of a passenger-to-freighter conversion programme for Airbus A320s and A321s.

EQUATORIAL GUINEA SIGNS C295 CONTRACT

ORDER Equatorial Guinea is scheduled to receive a C295 medium transport in September, under a two-aircraft deal signed with Airbus Defence & Space in Seville, Spain. To be delivered during 2017, the second example will be configured for a maritime surveillance role. Flightglobal's Fleets Analyzer database shows the central African nation's air force as including one Antonov An-72 transport.

SWEDES ASSESS DATA FROM CRASHED FREIGHTER

SAFETY Swedish investigators have obtained information from the damaged flight recorders retrieved from a West Atlantic Bombardier CRJ200 freighter which crashed on 8 January. The aircraft had been conducting a service to Tromsø, with two crew members on board, when its crew made an emergency call before air traffic control lost contact. Investigation authority SHK is now attempting to validate the retrieved data.

MALAYSIA ORDERS ARMED MD530G

ROTORCRAFT Malaysia has become the launch customer for MD Helicopters' MD530G, ordering six of the armed scout for its army. Deliveries will run between the fourth quarter of this year and March 2017, with the aircraft to carry an electro-optical/infrared sensor and an unspecified weapons package. First flown in 2013, the model has a maximum take-off weight of 3.75t, and a top speed of over 130kt (240km/h).

JAPAN READY TO FLY ATD-X DEMONSTRATOR

TECHNOLOGY Japan's ATD-X demonstrator is expected to make its first flight this month, with the Mitsubishi Heavy Industries-developed design having been rolled out for the media in Nagoya on 29 January. Unofficially named 'ShinShin', the aircraft is likely to conduct up to three years of testing of its stealth materials, thrust-vectoring IHI XF5-1 engines and advanced sensors; all of which could be used on an indigenous F-3 fighter during the 2030s.

FUNDING JAMES DREW WASHINGTON DC

US budget saves A-10, as 'arsenal plane' emerges

DoD reverses decision to retire close air support stalwart, ensuring combat capability until F-35 clears development

US defense secretary Ashton Carter has confirmed that its air force's at-risk fleet of Fairchild Republic A-10 ground-attack aircraft will remain in frontline use until early in the next decade, removing a threat of imminent retirement which had hung over the type for the last two years.

The announcement came during a speech delivered ahead of the Department of Defense's \$583 billion budget proposal for fiscal year 2017, which will be submitted later this month.

"[The type] has been devastating ISIL from the air," he says, in a reference to the campaign being mounted by the USA and coalition nations against Islamic State militants in Iraq and Syria. "The budget defers the A-10's final retirement until 2022, replacing it with [Lockheed Martin] F-35s on a squadron-by-squadron basis so we'll always have enough aircraft for today's conflicts."

The proposed new budget will include funding to extend the life and combat-relevance of other current combat types until the F-35 comes online. It will also boost research and development spending to \$71.4 billion.

Other initiatives outlined by Carter include a repurposed "arsenal plane", which would be used to carry a large volume of bombs and missiles.

"[Arsenal plane] takes one of our oldest aircraft platforms, and turns it into a flying launch pad for all sorts of different conventional payloads," he says. "In practice, the arsenal plane will function as a very large airborne magazine, networked to fifth-generation aircraft that act as forward sensor and targeting nodes – essentially combining different systems in our inventory to create wholly new capabilities."

Carter says the DoD is also investing in "fast, resilient micro-drones" that could be launched from a fighter travelling at Mach 0.9. The swarming, autonomous air vehicles – printed through additive layer manufacturing and using commercially-available components – were demonstrated during an operational exercise in Alaska last year.

Work on both concepts is being headed by a strategic capabilities office established in 2012 for the rapid development and fielding of new technologies. ■



"Devastating" ground-attack aircraft will remain in use until 2022



Iran offers
ambition, but
little clarity
THIS WEEK P12



Lockheed Martin

Pentagon's chief weapons tester says JPO schedule is unrealistic

PROCUREMENT JAMES DREW WASHINGTON DC

F-35 testing could run on into 2018, report claims

Operational evaluation of the Lockheed Martin F-35 Lightning II could be delayed by up to a year because of difficulties with completing developmental testing by a due date of August 2017, the Pentagon's chief weapons tester has cautioned.

In his annual F-35 report, published on 1 February, Michael Gilmore cautions against the US services committing to a three-year block buy of up to 270 of the type for fiscal years 2018 to 2020 before the completion of operational assessments.

The report claims completing developmental testing of the full-up Block 3F weapon system in 2017 is "unrealistic", and says the F-35 joint programme office (JPO) should "acknowledge the schedule pressures" and make

the necessary adjustments. "Full Block 3F mission systems development and testing cannot be completed by May 2017 – the date in the most recent programme office schedule," it says, adding flight testing "will likely not finish" before January 2018.

The report assumes maintaining a rate of 6.8 flight tests per month and completion of 7,230 planned Block 3F test points, plus the discovery of fresh faults.

Continuing an annual difference of opinion, the JPO says Gilmore's report "doesn't tell the full story", and overlooks efforts to resolve known technical challenges and schedule risk. Work is "on track for completion in the fourth quarter of 2017", it adds, with over 80% of developmental test points complete. ■

ANALYSIS STEPHEN TRIMBLE WASHINGTON DC

Boeing keeps coy over opportunity in middle market

Company official refuses to be drawn on potential plans to address gap in portfolio between 737 Max 9 and 787-8

Boeing is not revealing its plans for the so-called middle of the market, with its chief financial officer declining to be drawn on any possible new products to address a gap between the 737 Max 9 and the 787-8.

Greg Smith on 3 February, speaking at a Cowen and Company investors meeting, stopped short of making any comparisons to the dimensions of other aircraft in Boeing's portfolio. "It's premature to configure the airplane at this point," Smith said.

His statement came in response to a question from a Cowen analyst on whether Boeing is discussing a larger version of the 737 Max with a new wing as an option to fill the gap in the middle of its portfolio.

CUSTOMER NEED

"We're in constant dialogue with our customers to understand their needs today," says Smith, but notes that it does "see an opportunity" in that market segment.

Smith's ambiguous answer contrasts sharply with a Boeing response last year to news reports

suggesting it was considering reviving the 757-200 with new engines.

In that case, Boeing vice-president of marketing Randy Tinseth publicly denied the report a day later, saying that Boeing had studied such a concept a "couple" of times, but concluded there was no business case to support a 757 revival in the 2020s.

Launching a larger version of the 737 Max also would appear to clash with Tinseth's previous statements that a consensus had formed among customers around an aircraft about 20% larger than a 757. The 757-200 is itself more than 20% heavier than a 737 Max 9.

In the 3 February investor meeting, Smith offered more details about the potential timing for a new product. Nothing will come before the company's previously announced development projects, such as the 777X, Smith says. The 777-9 is scheduled for delivery in 2020, with the 777-8 following two years later.

"Anything would be post-777X," Smith says. ■

DEVELOPMENT STEPHEN TRIMBLE WASHINGTON DC

G500 readied for flight envelope expansion work

The first Gulfstream G500 test aircraft has completed a 50-flight battery of flutter tests, clearing the programme to proceed to more advanced flight envelope testing. All three flying prototypes have logged more than 430 flight hours on over 105 flights, Gulfstream says.

The programme is one-third of the way through a near-2.5-year campaign for airworthiness certification by the end of 2017, with

deliveries of the long-range, large-cabin jet beginning in 2018.

The second test vehicle has completed climatic chamber trials at the McKinley Climatic Laboratory at Eglin AFB, Florida. The aircraft was exposed to temperatures ranging from -40°C to 55°C over five days.

A fourth flight-test aircraft has entered final preparations before beginning airborne evaluations, Gulfstream says. ■



Gulfstream

A fourth Gulfstream aircraft is preparing for airborne evaluation

ANALYSIS DAVID KAMINSKI-MORROW LONDON

Iran offers ambition, but little clarity

Buoyed by the lifting of sanctions, Tehran has tentatively ordered large number of Airbus jets, although hurdles still remain

After nearly four decades of being forced to pick around scraps to keep its air transport operation functioning, Iran's government indulged itself less than two weeks after the lifting of nuclear-related sanctions.

Iran Air's tentative agreement for 118 Airbus and 40 ATRs appeared to bring partial clarity to its fleet-modernisation plans after days in which various officials mentioned a range of numbers.

"This is a huge market because Iran is a big country... they have very old aircraft so they have to change their fleet and grow very fast," said Airbus chief executive Fabrice Brégier as Iran Air sealed a heads-of-agreement for 73 long-haul jets – comprising 12 A380s, 16 A350-1000s and 45 A330s – plus 45 from the A320 family.

But a heads-of-agreement is not a firm order, and Brégier acknowledges that the deal must be converted and satisfy the "outside condition" of an export licence.

He indicates that the first deliveries will occur within months and run to 2023. But the precise schedule, and even the final composition of the order, has yet to become unequivocal.

Iranian president Hassan Rouhani's office suggests 17 aircraft will be handed over this year, while Iran Air chief Farhad



Image Broker/REV Shutterstock

Parvaresh says it will be between five and eight. While the 118 jets are new, the delivery picture is confused by the possibility of leased and second-hand aircraft being added to the mix.

INFRASTRUCTURE

ATR's schedule appears more certain. It says it will start delivering the first ATR 72-600s – of which 20 are firm – by the end of this year, adding that they will have 70 seats. Iran Air indicates that two to four aircraft will arrive this year.

Iran has a population the size of Germany and a territory more than four times larger, but its fleet is a tenth of Lufthansa's and includes long-haul airframes such as A300B2s and Boeing 747-200s that are 35 years old.

Taking all 12 A380s remains subject to commercial circumstances, it admits, as well as progress on the country's airport infrastructure. The proportion of

long-haul types in the plan might point to a desire to recapture Tehran's position as a regional hub. It has potential to shorten, compared with Dubai and Doha, some one-stop European-Asian routes.

But US carriers remain blocked from Tehran. And Gulf airlines have adopted liberal policies – such as provision of alcohol – that encourage travel via their hubs, although Gulf Air has demonstrated that having similar ingredients does not guarantee success.

Maintaining a restrictive regime is likely to result in Iran Air's having more in common with Saudia, which despite having an extensive fleet does not share the international marketing draw of its Gulf counterparts. The Gulf carriers have also established strong connections to Iran, capitalising on an absence of non-stop links between Iran and several geographic regions, channelling feeder traffic away from Tehran.

Iran Air has not specified routes on which it would deploy the dozens of aircraft, beyond vague references to putting A320s primarily on domestic services, with the long-haul jets likely to operate to North America and China.

The airline is still restricted by the EU over safety concerns, meaning a substantial training effort to convert pilots and maintenance technicians.

RESTRICTIONS

Sanctions had blocked the sale of aircraft with more than 10% of US-sourced content. But while the 16 January lifting of restrictions provided a window, the freedom will not apply to all Iranian carriers. Sanctions to curb support for terrorism-related activity remain.

Mahan Air, still bound by sanctions, has pursued unorthodox means to update its fleet, including complex third-party arrangements. "Secondary sanctions continue to attach to significant transactions with Mahan Air and other Iranian persons," says the US Department of the Treasury, adding that cargo aircraft are "not eligible" for licensing.

There is no indication whether the Iranian government, as Iran Air's owner, would have freedom to distribute aircraft acquired by the carrier to other operators. ■

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SPACEFLIGHT DAN THISELL LONDON

Virgin's 747 gains Cosmic makeover

Conversion of former-passenger airliner to begin shortly as launch company works to increase booster-rocket payload

Virgin Galactic's bid to enter the small satellite launch business is building momentum, with heavy work under way in Texas on modifications to the Boeing 747-400 that will serve as a dedicated air-launch carrier, while colleagues in California work to increase the payload capacity of the in-development booster rocket, LauncherOne.

At the Royal Aeronautical Society in London on 2 February, Virgin Galactic's executive vice-president of spaceport and programme development, Jonathan Firth, revealed the former-Virgin Atlantic 747 (N744VG), acquired in December by the launch operation, is now in Waco undergoing a D-check and will be transferred to San Antonio for transformation into a carrier aircraft. That effort is due to conclude this year.

Modifications at San Antonio will in part be determined by aerial work to test the flight profile needed for air launch operations, but is not on the overall

programme critical path. The rocket – an in-house liquid oxygen-kerosene design being advanced at Virgin Galactic's engineering and manufacturing centre, established last year in Long Beach – is due for flight testing in 2017.

LauncherOne and its "Newton" engine are being uprated to enable Virgin Galactic to put satellites of up to 300kg (661lb) into Sun-synchronous polar orbits, or of up to 400-450kg into equatorial orbits. The plan had called for LauncherOne to share the twin-fuselage WhiteKnightTwo carrier aircraft built for the company's suborbital tourism vehicle, SpaceShipTwo, but market signals that payloads needed to be bigger called for a larger carrier, hence the 747.

The payload plan has grown dramatically. The programme was revealed at the 2012 Farnborough air show as a scheme to lift up to 225kg to a low-inclination, low Earth orbit, or 120kg to a high-



Modification of the jumbo jet will be carried out in San Antonio

altitude Sun-synchronous orbit for a flight price of \$10 million. As late as spring 2015, the masses hadn't changed, but by September, when Virgin Galactic revealed it was shopping for dedicated carrier aircraft, the company said it would nearly double capacity, to up to 200kg to the 600-800km sun-synchronous orbits popular with Earth observation or scientific missions, or up to 400kg to low-Earth orbits for the same \$10 mil-

lion price tag.

Virgin Galactic is contracted to 39 flights – and 100 options – for UK-based OneWeb, which plans to orbit 900 Airbus Defence & Space-built microsatellites of less than 150kg each, to provide affordable broadband internet to rural areas around the world from 2019.

And in time-tested Virgin fashion, the new carrier aircraft is also getting a memorable name: "Cosmic Girl". ■

TECHNOLOGY STEPHEN TRIMBLE WASHINGTON DC

Geared turbofan patent faces GE Aviation protest

GE Aviation has petitioned the US Patent and Trademark Office to revoke several intellectual property claims assigned to competitors, including Pratt & Whitney's patent for the geared turbofan engine.

The petitions, filed on 29 January, invoke a new review procedure created by Congress in 2012 to adjudicate disputes over patent claims.

"As company policy, GE respects the valid intellectual property rights of third parties," the company says. "When GE identifies third-party patents it believes have been improperly granted, GE may decide to utilise the [review] procedure to address those."

P&W's patent for the geared turbofan engine features a turbofan that cycles power from a low-



Applications include the PW1500G for the Bombardier CSeries

pressure turbine through a reduction gear to drive an inlet fan. It replaces standard engine architecture in which the inlet fan is driv-

en directly by a low-pressure turbine. GE claims the concept was "well-known in the industry" decades before P&W applied for a

patent. GE's petition cites the company's work for NASA in 1979 on a design for a geared turbofan engine, which used a similar architecture, including a three-stage low-pressure turbine and a planetary-style reduction gear, as seen on P&W's system.

It has decided to challenge its rival's patent because otherwise the intellectual property claim is generally valid for 20 years.

"GE Aviation is taking early steps to clear potential obstacles for future aircraft and engine concepts that might emerge in the decades ahead," the company says. The patent office must first determine whether GE has filed a legitimate complaint. If accepted, a Patent Trial and Appeal Board will make a decision, but the process typically takes 18 months. ■

THE FUTURE LOOKS GREAT FROM HERE



On January 29, 2016, we saw the future—the first flight of the 737 MAX and a glimpse of what's to come. From lower operating costs to advanced technology, the 737 MAX is on track to deliver a new era of performance. That's a better way to fly.

See the first flight for yourself at boeing.com/737MAX





New CFM International engines, split-tip scimitar winglets and relofted tailcone will contribute to promised 14% cut in fuel burn

PROGRAMME JAMES DREW SEATTLE

737 Max takes a great Leap forward

First flight for Boeing's re-engined narrowbody ushers in 18-month test period, as airframer looks to catch A320neo

Boeing's lead 737 Max – “Spirit of Renton” – defied Seattle's drizzle to complete its maiden flight on 29 January, taking off over Lake Washington in front of thousands of cheering employees.

The CFM International Leap-1B-powered rival to Airbus's A320neo left early from Boeing's Renton, Washington factory, departing at 09:46 local time to avoid an approaching storm that threatened the occasion.

At the controls were Boeing 737 chief pilot Capt Ed Wilson and vice-president of flight operations Craig Bomben, who touched down at Boeing Field 2h 47min later, without incident.

“Luckily, we got out of Renton just in time,” says Wilson. “We didn't look back.”

Although the flightcrew took the twinjet up to 25,000ft, for the majority of the sortie they stayed at around 15,000ft and 250kt (463km/h). Though not the official start of flight testing, Boeing in the days following the sortie began its certification effort.

Keith Leverkus, vice-president and general manager of the 737 Max programme, speaking immediately after the flight, described it as a “beautiful landing” back at Boeing Field.

He paid tribute to the workers at Renton, who are steadily ramping up production to meet record

backlogs on the current 737NG and developmental Max 7, 8, 9 and 200.

“I believe we have just now ushered in the new era of the 737 as we complete the successful flight,” said Leverkus.

Employees will have their work cut out to meet Boeing's ambitious targets, however: in the week preceding the first flight the airframer announced that monthly 737 output will rise by 35% up to 2019, from 42 per month today to 57 by the end of the decade.

There are three lines now pumping out 737s in Renton, and the most recent addition, nestled between the east and west 737NG lines, is dedicated to assembling the Max family.

“I believe we have just now ushered in a new era of the 737”

KEITH LEVERKUS

VP, 737 Max programme, Boeing

“The plan since we launched the Max was to have our two existing lines produce at a high rate, and then our Max line would be our go-slow line as we learn about the Max,” says Leverkus. “Through 2016, we'll continue to build those Maxes at a fairly low rate while we continue flight test-

ing, and then in 2017, we'll deliver those airplanes.” Entry into service has long been planned for the third quarter of 2017, with launch customer Southwest Airlines, but Boeing hopes to claw back some of the lead held by the rival Airbus A320neo, the first example of which was delivered last month.

Bomben anticipates “about nine months of flight testing,” and says the second aircraft is approximately one month away from joining the campaign.

LEAP AHEAD

Leverkus is optimistic about meeting – or even exceeding – the promised 14% saving in specific fuel burn over the CFM56-powered 737NG.

“Compared to the initial NGs, we're over 20% improved fuel efficiency,” he says. “Frankly, initial indications are that we can do even better than 14%.”

Key to the Max's fuel-saving goals are the Leap-1B powerplants which CFM is confident of gaining certification for soon, although it declines to offer a specific date.

To date, 6,144 Leap-1Bs have been ordered as the Max backlog reaches 3,072 aircraft for 62 customers. CFM says the engine has completed more than 8,000h across 17,000 cycles of ground and flight testing since June 2014, including almost 300h over 50

flights on a 747 flying testbed.

“We couldn't be more proud to achieve this major milestone in our long history with Boeing; a relationship that began in 1981 with the launch of the 737 Classic,” says CFM International chief executive Jean-Paul Ebanga.

WINGLETS

Aside from the engines, the Max also includes a new flightdeck, fly-by-wire spoilers, relofted tailcone and advanced technology winglets that contribute a 1.5% fuel-burn improvement.

Boeing lags behind its European rival, both in terms of service entry date and order numbers. Today, the A320neo enjoys a backlog of approaching 4,500, compared with 3,000 for the 737 Max – a roughly 60/40 split. But Leverkus is determined to regain market share and make the Max the best-selling narrowbody.

“We have a terrific product, not only in terms of technology and the fuel savings we are really confident of achieving, but we really think it will be the preferred airplane as well,” he says. “We're quite confident as we step through our flight-test programme, we're going to be able to realise and deliver the improvements we assured our customers we're going to be able to provide.” ■

See Graphic P18



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MAXIMUM REACH

With Boeing's new 737 Max having successfully completed its first flight on 29 January, we use data from Flightglobal's Fleets Analyzer database to analyse the geographical spread of its customer base

PAUL RIGNALL LONDON

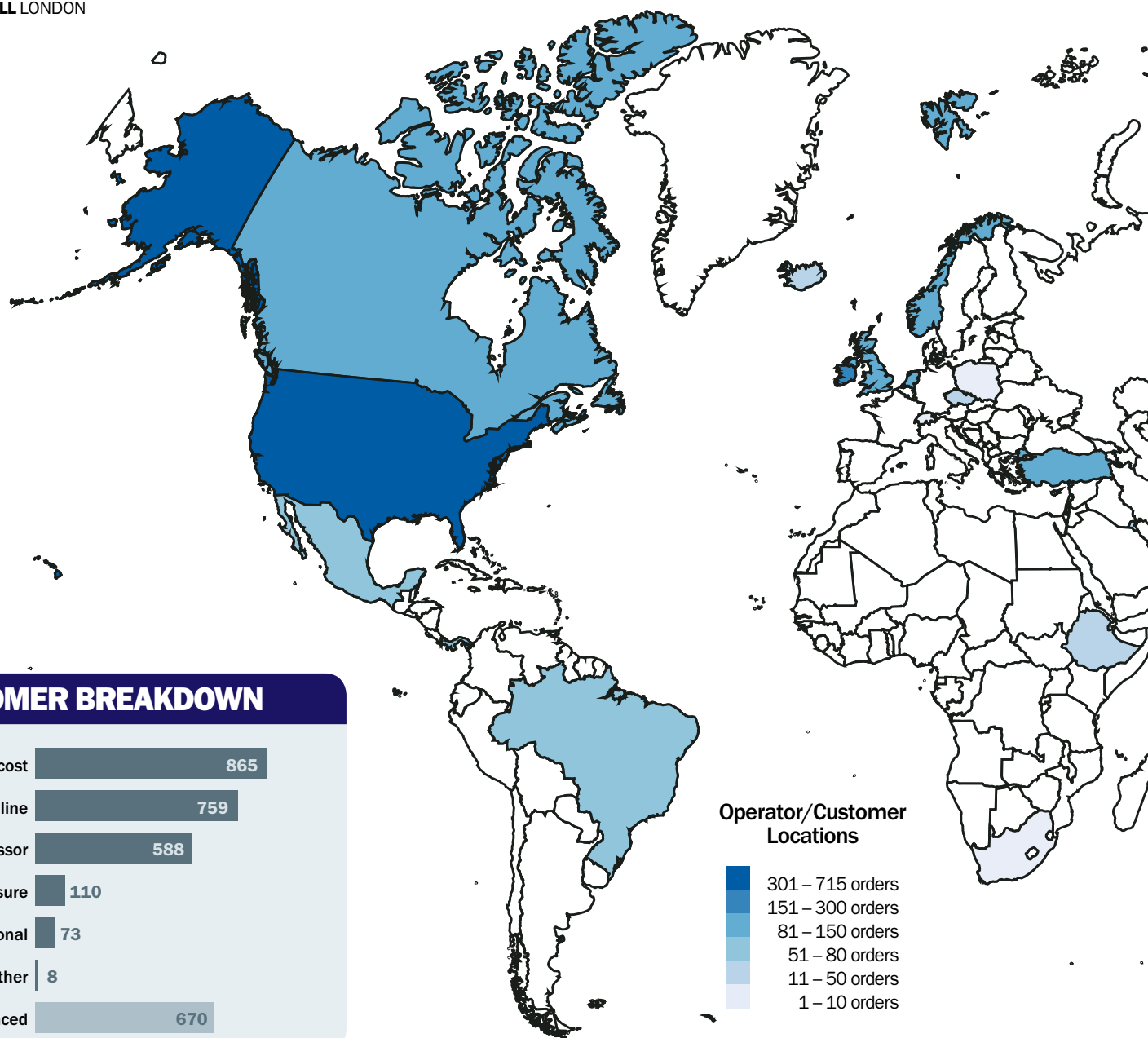
TECHNICAL SPECS

	Max 7	Max 8	Max 9	Max 200
Height (m)	12.3	12.3	12.3	12.3
Length (m)	33.7	39.5	42.2	39.5
Wingspan (m)	35.9	35.9	35.9	35.9
Pax (1-class)	144	184	204	200
Pax (2-class)	126	162	178	—
Pax (max.)	149	189	220	—
Range – 2-class layout (nm)	3,750	3,515	3,515*	2,700**

NOTE: *With optional auxiliary fuel tank **Single-class layout SOURCE: Boeing

CUSTOMER BREAKDOWN

Low-cost	865
Mainline	759
Lessor	588
Leisure	110
Regional	73
Other	8
Unannounced	670



FIRST FLIGHT

Taking off from Boeing Field in Washington State, the initial 737 Max 8 test aircraft became airborne for the first time on 29 January, performing a 2h 47min sortie. This kicks off an 18-month test and certification campaign that will eventually involve a total of four flight-test prototypes. Boeing has already made inroads into that task, having commenced its certification flight programme in the days immediately following the type's debut.

VARIANTS

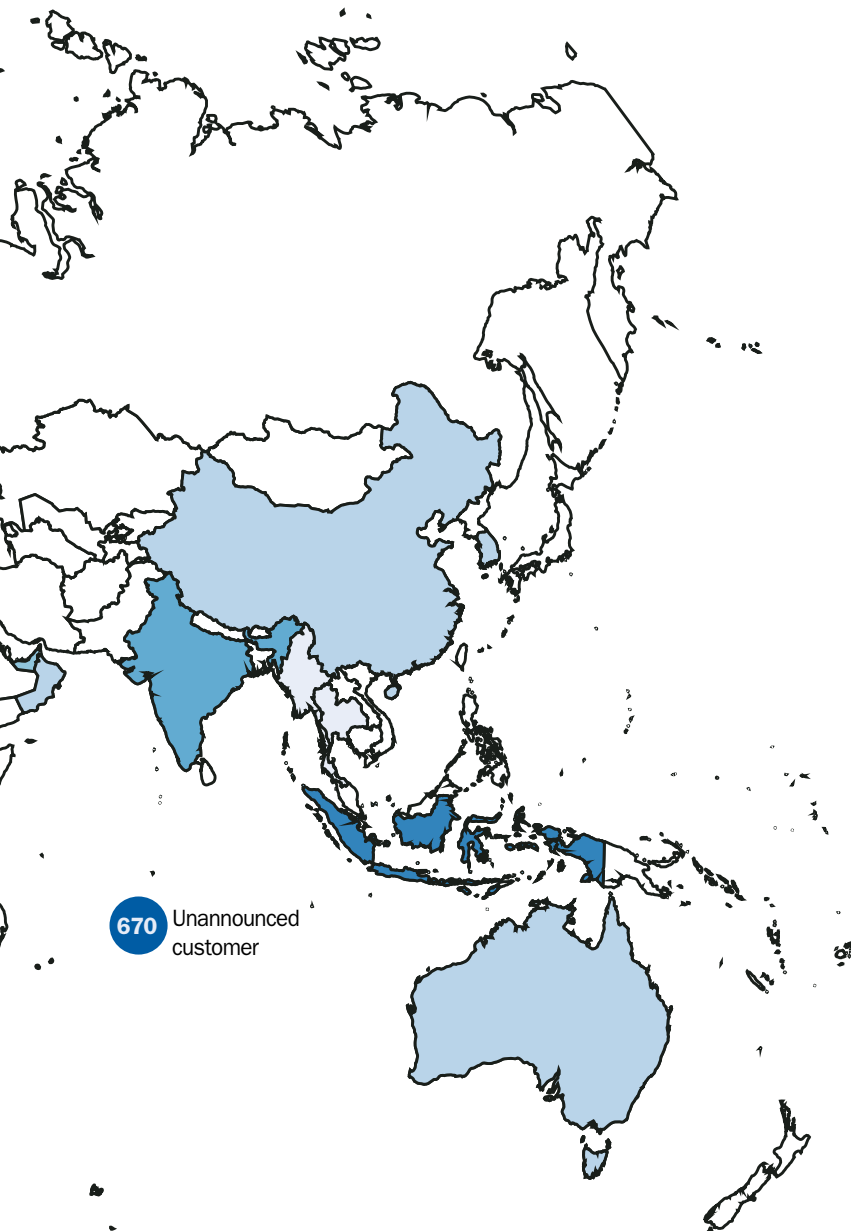
Boeing will build four variants of the re-engined Max. Of these, three – the 7, 8 and 9 – correspond to the existing 737NG family in terms of size and passenger volume, plus there is the high-capacity 200, initially for launch customer Ryanair. All will be powered by CFM International Leap-1B engines, and feature split-tip scimitar wing-tips and a re-located tail cone for better aerodynamic performance and 14% lower fuel burn than the NG. The Max also gains a new cockpit derived from that on the 787.

ORDERS

Since launching the programme in 2011, Boeing has taken in 3,073 orders for the Max family, with the baseline 8 variant accounting for 60% of the total. With 100 orders, Ryanair is currently the only customer for the Max 200 (a Max 8 configured with 200 seats), while the Max 7 and Max 9 have accumulated 60 and 223 orders, respectively. The slow sales of the smallest family member reflect a broader industry trend of airlines selecting larger aircraft. A further 844 commitments offer flexibility on the eventual variant.

PRODUCTION

The Max will eventually be assembled on three assembly lines at Boeing's Renton, Washington factory. Based on the substantial order backlog of both the NG and the Max, Boeing intends to raise 737 production from 42 per month at present to 57 per month by 2019. Launch customer Southwest Airlines is expected to receive its initial 737 Max 8 in June 2017, although the manufacturer has hinted that this timetable could be advanced if testing progresses favourably.

**LARGEST ORDERS****Lion Air 201 orders**

The Indonesian low-cost carrier is set to operate an undetermined split of the type.

**Southwest Airlines 200 orders**

The US budget carrier has 30 orders for the smallest family member, the 737 Max 7, alongside 170 of the larger Max 8. It aims to operate only 737NG and Max aircraft by 2021.

**Air Lease 112 orders**

Based on announced deals, 13 of Air Lease's ordered Max 8s will be operated by Oman Air, Sunwing Airlines and Travel Service Airlines.

**Norwegian 100 orders**

The Oslo-based low-cost carrier is considering utilising its fleet of Max 8s on certain transatlantic routes.

**United Airlines 100 orders**

The Chicago-based airline has opted to place orders for the larger 737 Max 9.

**American Airlines 100 orders**

American's order is composed of Max 8s, with the first set to be delivered in October 2017.

**Ryanair 100 orders**

The Irish budget carrier will be the launch customer for the high-density 737 Max 200.

**AerCap 100 orders**

Czech charter firm Travel Service Airlines will operate 10 of the lessor's Max 8s.

SOURCE: Flightglobal's Fleets Analyzer database



PROGRAMME MAVIS TOH SINGAPORE

MRJ test flights to restart this month after modification

Japanese manufacturer completes structural strengthening of prototype and clarifies reasons for delay to service entry

Mitsubishi Aircraft has completed structural modifications to its initial MRJ flight-test aircraft, with the regional jet set to resume evaluations in February.

Prototype FTA 1 has been on the ground since its third sortie, on 27 November 2015, undergoing structural reinforcements and system software upgrades.

The Japanese manufacturer identified the need to strengthen the aircraft's wing roots and the fuselage frame above the centre wing after it conducted structural

tests before the aircraft's first flight, on 11 November 2015.

It has since applied a "temporary treatment" to strengthen the sections, says Mitsubishi Aircraft's head of strategic marketing Hideyuki Kamiya.

"For the flight-test aircraft, we added additional plates on the original parts for reinforcement... for the production aircraft, we will redesign these parts to increase the thickness a little bit and the weight influence is within a few kilograms," says Kamiya.



Developmental twinjet made its first flight on 11 November 2015

Mitsubishi Aircraft

Mitsubishi additionally clarifies its announcement in December 2015 of a delay to first delivery – moving to mid-2018 from the second quarter of 2017 – is not related to the modifications. It says it wants to perform extra ground test simulations before the first flight of each prototype and take additional time to analyse data gleaned during test flights.

"After talking to aviation experts [at our] Seattle engineering centre... we reviewed with them

our entire flight-test programme," says Kamiya.

The two requirements combine to add about a year to the test and certification programme, he says.

Mitsubishi Aircraft will use five Pratt & Whitney PW1200-powered MRJ test aircraft for the certification campaign, which is expected to cover 2,500h of evaluations, the majority to take place in the USA.

So far the programme has accumulated 223 firm orders. ■

TECHNOLOGY ALEX DERBER LONDON

EasyJet hails fuel-saving potential of hybrid taxiing

UK low-cost carrier EasyJet is banking on a new 700kg (1,540lb) taxiing system to save it about 50,000t of fuel per year.

The concept envisages motors in the main gear powered by a hydrogen fuel cell in the hold, which charges using energy captured from the brakes on landing.

Pilots will be able to manoeuvre on the tarmac using the motors in-

stead of their main engines. Taxiing currently accounts for about 4% of the airline's fuel bill and about 20min of each aircraft's journey time.

EasyJet promises the estimated fuel savings take into account the extra weight of the new system. And although it declines to say how much a fleet-wide upgrade of its Airbus A319s and A320s would

cost, the airline is sure that the technology will pay for itself.

"We have done the calculations and are confident that over the lifetime of the aircraft, the fuel benefits will make the system cost-effective," says EasyJet.

The carrier says a zero-emissions system is "best designed from the ground up" rather than a bolt-on to existing components

along the lines of WheelTug's nose gear-mounted motor.

Water will be the only waste produced by the hydrogen fuel cell and could be used to replenish the aircraft's supplies.

Working with the UK's Cranfield University, EasyJet plans to unveil a mock-up and a working example of the new system in the coming months. ■

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AIR TRANSPORT P25

PROGRAMME STEPHEN TRIMBLE WASHINGTON DC

Alcoa to supply 777X alloys

Cargo floors of Boeing long-haul twinjet to be manufactured from aluminium-lithium material

Boeing has selected metals specialist Alcoa to supply aluminium-lithium alloys for the cargo floors of its developmental 777X widebody twinjet family.

The airframer's choice of the lightweight and corrosion-resistant material for the 777X adds to its growing use by the industry.

A decade ago, aluminium alloys seemed to be on the wane as an aerospace material, as airframers turned to carbonfibre composites to make weight savings in primary structures.

But the development of aluminium-lithium alloys has helped metals make a comeback. In 2010, Bombardier selected Constellium's Airware-branded aluminium alloys for the fuselage skins, stringers, frames and floor beams of its CSeries, with Airbus later picking the same product for wing components on the A350 family.

After investing heavily in composites on the 787, Boeing has moved back to metals, partly as a result of product decisions. The choice to launch the re-engined

737 Max and the 777X meant that both aircraft's aluminium fuselages would be retained, although Boeing is moving to a composite wing for the 777X.

In September 2014, Alcoa announced a \$1 billion deal with Boeing that included consideration of "advanced aluminium alloys" on future aircraft. The most recent deal with Boeing also makes Alcoa the supplier for advanced titanium forgings for the landing gear and "complex nacelle fittings" on the 737 Max. ■

INCIDENT DAVID KAMINSKI-MORROW LONDON

A340 damaged at Madagascar

Investigators are looking into a serious incident in which a Turkish Airlines Airbus A340-300 struck the instrument landing system (ILS) before landing at Madagascar on 9 January.

French investigation authority BEA says the aircraft (TC-JDN) struck a localiser antenna – about 175m before the threshold – with its left main landing-gear, before touching down about 50m short.

The A340 spent 24h undergoing repairs, and the damage to the antenna left the ILS inoperative for "several days", says BEA. ■

OPERATIONS EDWARD RUSSELL WASHINGTON DC ELLIS TAYLOR SINGAPORE

New routes show airlines willing to go the distance

Two carriers on 29 January unveiled non-stop routes that, at over 7,000nm (13,000km) each, will be among the longest flown.

Emirates, which already holds top spot for sector length with its recently started Dubai-Panama City service (7,466nm), has announced another route that keeps it on top of the heap: from 1 March it will link its home base with the New Zealand city of Auckland, flying the 7,668nm leg non-stop using a Boeing 777-200ER.

Meanwhile, United Airlines is from 1 June to begin a 7,339nm service between San Francisco and Singapore using a 787-9.

United retains the crown for the longest Dreamliner flight, held by its 6,905nm-long Los Angeles-Melbourne route. ■

LONGER LONG-HAUL ROUTES



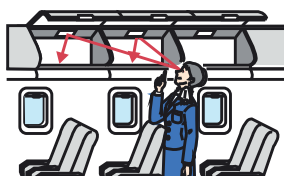
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Fixed-wing trainer deal signed by UK
DEFENCE P26

REPORT GREG WALDRON SINGAPORE

Probe slams TransAsia safety culture

Investigators identify “dozens of failures” at Taiwanese carrier following 2014 fatal crash of an ATR 72-500 at Magong

Safety lapses at TransAsia Airways contributed to a 2014 fatal accident involving an ATR 72-500 which came down in stormy weather near Taiwan’s Magong Island, investigators have determined.

Flight GE222 from Kaohsiung to Magong crashed into a residential area on 23 July during an attempted go-around, killing four crew and 44 of 54 passengers.

During its final approach at 19:05 local time, the turboprop (B-22810) overflew the missed approach point for Magong’s runway 20 at 176ft – 154ft lower than the minimum descent altitude. It levelled off for 10s, before continuing its descent on a VOR approach, although heavy rainfall had reduced the runway visual range to just 500m.

As it reached 72ft, the ATR had drifted well to the left of the runway centreline, causing the pilots to call for a go-around. But 2s after the power levers were advanced, the aircraft collided with trees, coming down 850m north of the runway.

In its final report into the accident, Taiwan’s Aviation Safety Council (ASC) says “flightcrew co-ordination, communication, and threat and error management were less than effective.” The first officer, it says, failed to challenge



Turboprop’s crew attempted go-around after unstable approach

dropping below the minimum descent altitude and did not detect deviation from the approach track “or identify those factors increased the risk of a controlled flight into terrain.”

It adds: “Non-compliance with standard operating procedures was a repeated practice.” Cross-

checking was virtually non-existent between the flightcrew, a 60-year-old former army pilot with 19,000h on ATRs and a 39-year-old first officer with 20h.

It suggests the difference between the two could have made the first officer reluctant to challenge the captain. Despite his high

skill level, interviews revealed he was prone to taking risks. “Interviewees said the captain landed safely in adverse weather previously because of his proficiency, where some might have initiated a missed approach.”

TransAsia’s flight operations manager was aware of the captain’s behaviours, but “safety notices regarding [standard operating procedures] compliance were clearly ineffective”. The ASC found dozens of failings in TransAsia’s risk management. It highlights poor procedures, ineffective safety meetings, invalid risk indices, and questions commitment to safety.

It also recommends the country’s Civil Aeronautics Administration strengthen its oversight. ■

REACTION

Airline promises root-and-branch overhaul of procedures

TransAsia Airways has pledged to improve standards after an investigation into a fatal 2014 crash revealed a dysfunctional safety culture.

In a five-page statement, TransAsia accepts the findings of Taiwan’s Aviation Safety Council and says the airline has moved to improve its procedures.

Last year, it engaged international experts to conduct an audit and

make recommendations on areas for improvement. It also set up a flight safety committee, which the board oversees, to ensure safety policies are implemented. TransAsia will work with training academies to ensure its Airbus A320 and ATR 72 pilots have sufficient levels of instruction, it says.

Pilots will undergo half-yearly simulator assessments, with those who fail removed from operations for fur-

ther training. Crew management will be strengthened, with incentives for pilots with a clean record and disciplinary action, including dismissal, for those who do not comply.

Over the past year, the airline has recruited experienced senior executives from other airlines to work on enhancing safety, it adds. The privately-owned Taiwanese carrier also pledges to keep its fleet young. ■

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CONTRACTS CRAIG HOYLE LONDON

Fixed-wing trainer deal signed by UK

Three new types included in £1.1bn package to transform effectiveness of nation's tri-service pilot instruction system

The UK Ministry of Defence has signed contracts worth £1.1 billion (\$1.58 billion) to cover the remaining fixed-wing elements of its Military Flight Training System (MFTS) infrastructure. The deals span a trio of new aircraft types and ground-based training equipment.

Worth around £500 million and awarded to Elbit Systems/KBR joint venture Affinity Flying Services, the aircraft package will introduce the Grob Aircraft G120TP "Prefect", Beechcraft T-6C and Embraer Phenom 100.

In addition, Affinity will be responsible for maintenance and

support services for the fleet under the private finance initiative deal. Also included in the project cost – which will cover activities until May 2033 – are contracts for Lockheed Martin and Babcock, to "deliver all of the ground-based training equipment and infrastructure", says Ascent Flight Training, the MoD's delivery partner for MFTS.

Selected in October 2014, Affinity's fixed-wing package comprises 23 G120TPs, 10 T-6Cs and five Phenom 100s, which will, respectively, be used for elementary, basic and multi-engine training.



Affinity Flying Services

Agreement will see 10 Beechcraft T-6Cs enter use in early 2019

Ascent says initial course capability will be declared with the G120TP at the end of 2017, in mid-2018 for the Phenom 100 and early in 2019 with the T-6C. Full operational capability for the package – which will replace the UK's Grob G115 Tutors, Shorts Tucano T1s and Beechcraft King Air 200/350s – should be achieved later during 2019.

Phenom 100 provider Embraer says its subcontract with Affinity "includes support services and an option for additional, follow-on aircraft", but Ascent says there are no discussions to investigate increasing the size of the training fleet. However, expected demand for multi-engine pilot training increased late last year, due to an MoD decision to extend operations with part of the Royal Air Force's Lockheed C-130J tactical transport fleet, and to acquire nine Boeing P-8A maritime patrol aircraft.

"Modern training aircraft selected specifically to meet the bespoke needs of the UK's armed forces will deliver optimised training, alongside high-tech simulators and classroom trainers," says Ascent managing director Paul Livingston.

Other parts of the tri-service MFTS infrastructure in use include the RAF's BAE Systems Hawk T2 advanced jet trainers, and King Air 350 Avengers used by the Royal Navy Fleet Air Arm for observer training.

Industry sources suggest a contract for the rotary-wing aspect of MFTS could be signed within approximately the next two months. This will provide replacements for the Airbus Helicopters AS350s and Bell Helicopter 412s operated by the Defence Helicopter Flying School. Candidate types include models from AgustaWestland and Airbus Helicopters. ■



Craig Hoyle/Flightglobal

The Grob G120TP and Embraer Phenom 100 complete the lineup

DEVELOPMENT ARIE EGOZI TEL AVIV

Meteor expects to have big Impact on UAV market

Flight International has obtained details about the Impact unmanned air vehicle being developed by new Israeli company Meteor Aerospace.

Powered by a 100hp fuel-injection engine, the medium-altitude, long-endurance Impact can carry a 150kg (330lb) payload, and has a quoted flight endurance of greater than 24h. It is Meteor's first UAV design.

Formed in 2013, the privately-owned company has operated with minimal exposure, avoiding trade shows and limiting its announcements. "We're still

flying under the radar," says one executive. Meteor is the initiative of co-founder and chief executive Itzhak Nissan – a former head of the nation's largest UAV manu-

facturer; Israel Aerospace Industries. He established the new venture with Israeli businessman Hezi Bezalel.

"Coming to the defence market

with a new company makes sense only if you bring new and innovative products. You can't claim a place among the industry giants if you offer more of the same," says Nissan. He says the company has secured orders for the Impact and other systems worth \$100 million, plus options worth another \$150 million.

Meteor is developing two other UAVs, Nissan reveals. "One will be bigger than the Impact, and the other smaller." Its activities also include developing unmanned ground and maritime systems, and precision strike weapons. ■



Meteor Aerospace

Israeli company promises endurance of over 24h for new type



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MODIFICATION JAMES DREW WASHINGTON DC

747-8 up to PAR as new Air Force One

Boeing receives first risk-reduction contract linked to adapting widebody type for future role as US presidential transport

One year after being announced as prime contractor, Boeing is formally on contract to replace the USA's 747-200-derived "Air Force One" fleet with up to three modified 747-8s.

The US Air Force in January 2015 announced the sole-source selection of the 747-8, ending any chance of an upset victory for the only Western-built four-engined alternative, the Airbus A380.

On 29 January, Boeing received its first contract under the USAF's Presidential Aircraft Recapitalisation (PAR) programme. The initial, \$25.8 million deal aims to reduce risk before the launch of an engineering and manufacturing development phase in 2017.

"This is the start of our contractual relationship with

"This is about getting the best value for the taxpayer and meeting the needs of our commander in chief"

COL AMY MCCAIN
PAR programme chief



Replacing the US Air Force's two VC-25As is an urgent priority

Boeing," says PAR programme chief Col Amy McCain. "This initial effort is about reducing risk, really understanding where the tough work will be, finding affordability opportunities, and getting the best value for the taxpayer, while continuing to meet the needs of our commander in chief."

Boeing rejected several requests by the Department of Defense to sell 747-8 technical data to third parties wanting to compete for the prime system integrator's position. One unnamed company offered to reverse-engineer the widebody to obtain the

necessary technical data and certifications, but this was deemed too expensive compared to advancing the project with the airframer, the air force says.

The USAF maintains it made every effort to facilitate competition, but says that introducing a third-party prime contractor could have imposed "\$200-400 million in duplicative costs" and delayed initial operational capability by three years. Instead, the service hopes to obtain technical data to the "maximum extent possible" and compete for future requirements, such as upgrades and sustainment.

The initial funding represents Phase 1 of "pre-milestone B" efforts to run through April 2017, at which point the USAF intends to transition to development. Two 747-8s will be purchased initially, with an option to buy a third later.

Contract placement came only days after Boeing disclosed its fourth rate cut in two years at the 747-8 factory in Everett, Washington, along with an \$885 million pre-tax charge. By September, it will be producing six of the aircraft per year, down from a current rate of 1.3 per month.

Replacing the ageing VC-25A presidential aircraft stationed at Andrews AFB in Maryland is a priority for the air force. It seeks to keep two aircraft on standby at all times to support the president, while a third undergoes maintenance. The service says this concurrent availability rate "could fall to 28% in the 2025 timeframe", compared with projections of 56% for modern 747-8s.

Delaying replacement by one year could add \$255 million in maintenance and modification costs, doubling to \$510 million for two years, it notes. ■

DEVELOPMENT GREG WALDRON SINGAPORE

HAL rolls out first prototype of HTT-40 basic trainer

Hindustan Aeronautics (HAL) has rolled out the first prototype of its HTT-40 basic trainer. The aircraft will undertake ground runs and taxiing tests prior to its first flight, the company says.

"It is important that all of us work towards meeting deadlines by overcoming challenges to meet the expectations at various levels," says HAL managing director Suvarna Raju.

"The project has managed to steer through the initial headwinds and now is going full throttle." He adds: "There are plans to weaponise and optimise" the platform.

The roll-out follows HAL's 2015 selection of the Honeywell TPE331-12B turboprop to power the aircraft.

India's defence ministry intends to buy 68 of the locally-developed trainer to satisfy a portion of its 180-aircraft requirement to replace the outdated HAL HPT-32 Deepak. The remainder of the need will be met using a fleet of Pilatus PC-7 Mk IIs. Flightglobal's Fleets Analyzer database shows that the air force operates 75 of the Swiss-built type, with options on a further 38.

Air force officials have long expressed a preference for the PC-7 Mk II over HAL's indige-

nous model. The state-owned company notes that the turboprop is the first of its designs to have been created digitally, and says that 70 of the type's 90 line-replaceable units are being

supplied by its divisions.

"Ground runs will be conducted with the assistance from the engine OEM" at the Aircraft Research and Design Centre in Bengaluru, says HAL. ■



Honeywell's TPE331-12B engine will power the indigenous type



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HELICOPTERS DOMINIC PERRY LONDON

Paris could speed up rotary renewal

Broad range of requirements under tri-service HIL project prompts France to consider accelerating 2020 schedule

France will decide next year whether to bring forward the timeline for a wide-ranging procurement to replace hundreds of light and medium helicopters operated by its armed forces.

Under the nascent *hélicoptère interarmées léger* (HIL) programme, Paris intends to begin the acquisition process in 2020. However, with aged types reaching the end of their operational lives – notably the navy's 22 *Aérospatiale SA316 Alouette III*s – the DGA defence procurement agency is studying whether to accelerate the replacement effort.

"The timeline is still under study and will depend on choices that remain to be made," the DGA says. "Possible solutions are being assessed; the feasibility to accelerate the programme will be studied by 2017."

But HIL is a daunting undertaking.

The army
is targeting
Gazelle
replacement



Apercu/SIPA/REX/Shutterstock

ing. France is seeking to replace a broad range of types across weight classes up to around 7t, and which conduct a variety of missions. These include the air force's Airbus Helicopters AS555 Fennec light attack rotorcraft and SA330 Pumas; the Puma transports and SA341/342 Gazelles used in the reconnaissance and light attack role by the army, along with its

Fennec trainers; and the navy's multirole AS365 Dauphins, AS565 Panthers and Alouette III's.

Were Paris to replace its inventory on a like-for-like basis, 422 helicopters could be required, based on data in Flightglobal's Fleets Analyzer database. However, its eventual acquisition is likely to be well below this figure.

Key to its deliberations will be

whether to acquire single or multiple platforms for the wide-ranging requirement. "Several options are being studied – a single or several platforms to match the whole spectrum of missions," says the DGA. "The choice will have to optimise requirements, calendar and resources."

If a decision is taken to increase the pace of the procurement programme, new helicopters could begin to arrive in the early 2020s, army sources indicate.

Speaking at a recent conference in London, Maj Gen Olivier de la Motte, commander of French army aviation, said that although the service's need is less urgent – its Gazelle fleet is currently scheduled for retirement in 2028 – given the attrition from operations, notably in Mali, "it could be interesting to have a new helicopter in 2022". ■

PROCUREMENT ARIE EGOZI TEL AVIV

Israel widens field for unmanned systems contest

Operational feedback from infantrymen has led to the Israel Defense Forces (IDF) including rotary-wing unmanned air vehicles in its search for a new battalion-level system.

A request for proposals for the requirement is expected by mid-2016, and is likely to outline a need to introduce a system weighing 2kg (4.4lb), including an electro-optical sensor payload, and offering an endurance of 20-30min. The price of each air vehicle will be a significant factor, because it is expected that in many combat situations units will

not be recovered. The IDF's operational aim is to allow a large number of infantry soldiers in any formation of a battalion-level unit to operate UAVs.

Only one part of Israel's ground forces uses UAVs, with the artillery corps' "Sky Rider" unit operating Elbit Systems' Skylark I-LE. The hand-launched type is designed for data collection and targeting missions, at ranges exceeding 32.4nm (60km). Operations in the Gaza Strip in 2014 led Tel Aviv to last year revive its acquisition plan to obtain a system for more widespread use. ■



Israel Defense Forces

Smaller type will complement use of artillery corps' Skylark I-LE

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CAPABILITY GREG WALDRON SINGAPORE

Ensuring Singapore's defensive edge

Head of city-state's air service looks forward to acquiring new transport helicopter and completing evaluation of F-35 variants

It is said Singapore has the world's most tightly-guarded airspace. A casual browse through the Republic of Singapore Air Force's (RSAF) list of combat types suggests this is true. The tiny country, which measures 700km², boasts more than 100 combat aircraft, of which a large portion are Lockheed Martin F-16C/D Block 52s, backed up by Boeing F-15SGs.

The man responsible for this force for the last three years is Maj Gen Hoo Cher Mou. Hoo has served with the air force since 1984 and his educational credits include Cambridge, Harvard, and the Royal Australian Air Force Command and Staff College. Unlike past RSAF chiefs, Hoo never served as a combat pilot. He is an expert on air defence and once led the service's 203 Sqn, tasked with monitoring and controlling Singapore's airspace.

Despite its powerful military, Singapore resides in one of the world's more peaceful regions. Although the site of a major battle in the Second World War owing to its strategic location, as a sovereign nation the country has never been at war. Nonetheless, in an email interview with *Flight International*, Hoo stresses the importance of being ready.

"The mission of the RSAF will always be to defend our skies and to safeguard our sovereignty"

MAJ GEN HOO CHER MOU
Chief, RSAF

"Our regional security environment is becoming increasingly complex and challenging, given the increased tensions in the South China Sea and the real threat of terrorism and extremism," he says. "The emergence of hybrid warfare such as the conduct of cyber-attacks and



The Republic of Singapore Air Force boasts an advanced combat fleet including 60 F-16C/Ds

information operations, could also pose a greater challenge to our security environment."

To deal with this, Hoo says the RSAF's acquisition strategy is geared to develop capabilities that can be used in wide-ranging scenarios, allowing it to meet both conventional and non-conventional threats. Apart from just buying hardware, the service emphasises training and people.

FUTURE FIGHTER

Hoo is candid about the air force's broader role, but his comments are carefully calibrated. One pointed question posed was about Singapore's degree of interest in Lockheed's short take-off and vertical landing F-35B. Its defence minister has seen demonstrations of the Joint Strike Fighter variant in the past, and industry observers feel the model is the ideal platform for land-scarce Singapore.

"The RSAF has identified the F-35 as a potential candidate to enhance our fighter fleet, and is in the advanced stages of evaluating the F-35," says Hoo. "Each of the F-35 variants has its unique strengths that could enhance our operational capability. We will make our final decision when we are satisfied that this state-of-the-art, multi-role fighter meets our



Hoo is tight-lipped on plans

long-term defence needs, is on track to be operationally capable, and most importantly, is a cost-effective platform."

In a similar vein, he offers little information about perhaps the greatest question facing his service at this year's Singapore air show: which new rotorcraft will replace the country's Airbus Helicopters AS332/532 Super Pumas/Cougars? He says only that suitable, cost-effective replacements are being considered, and that "we expect a decision soon". Front-runners for the requirement are believed to include the NH Industries NH90 and Sikorsky S-92. Hoo also sheds light on Singapore's permanent deployment of six Alenia Aermacchi M-346 advanced jet trainers with 150 Sqn at Cazaux air base in

France. He says pilots trained on the type have "benefited significantly from the enhanced quality and realism of our flying training."

He implies, however, the road has not been entirely smooth.

TRAINING ISSUES

"Being the first air force to train students on the M-346 means that there are no earlier references," he says. "We do encounter issues which may be expected in operationalising a new training system and we are working closely with Alenia Aermacchi to resolve them. Aermacchi has assured us that [it remains] fully committed to the RSAF M-346 programme and will do [its] utmost to ensure that we reap the full benefits of the advanced jet trainer."

Hoo adds, realistic scenario training continues to play a role for the RSAF's frontline fighters. The service is a regular participant in bilateral and multilateral exercises. "The mission of the RSAF will always be to defend our skies and to safeguard our sovereignty," says Hoo. "While our core mission will remain unchanged, we recognise that the security environment is becoming increasingly complex, given the rise of non-conventional threats, such as transnational terrorism." ■

See Feature P40

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A view of a city at night from an airplane window. The city lights are visible through the oval window frame, with a bridge and water in the foreground. The sky is a mix of orange and blue, suggesting dusk or dawn. The text "FROM TOKYO TO TOMORROW" is in white, and "A BETTER WAY TO FLY." is in yellow.

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SEAPLANES KATE SARSFIELD LONDON

Funding in place for Seastar relaunch

Wuxi-based Dornier will unveil revamped amphibian during Singapore air show, and also reveal its pivotal Chinese backers

Dornier Seawings plans to relaunch its Seastar amphibian at the Singapore air show later this month – 25 years after the programme was halted – and has selected Diamond Aircraft Industries in Canada to manufacture the twin-engined turboprop's all-composite airframe.

Dornier, headquartered in Wuxi, China, says the Seastar will re-emerge with a new propeller and landing gear, details of which will be announced in Singapore. It also will have a Honeywell Primus Epic 2.0 avionics suite, and a choice of interiors to suit the VIP, corporate, commuter, cargo and air ambulance markets.

The Pratt & Whitney Canada PT6A-135A-powered Seastar was unveiled in the early 1980s and secured US and European certification in 1991. A shortage of funding forced Dornier to halt production that year, before a single aircraft was delivered. Subsequent attempts to relaunch Seastar production were also thwarted due a lack of investment.

"We always planned to launch series production once we had the



Diamond Aircraft Industries will make the turboprop's airframe

financial backing," says Dornier Seawings co-founder and chairman Conrado Dornier. "We are now fully funded through our two Chinese partners, who will be announced in Singapore, and are ready to proceed."

Peter Maurer, president and chief executive of London, Ontario-based Diamond, describes the Seastar as a "sophisticated and substantial aircraft with a maximum take-off weight of over 10,000lb [4,530kg] and capacity to carry two crew and up

to 12 passengers". Maurer says while the aircraft "is entirely different" to any of the piston single and twin-engined models made by Diamond to date, "there are significant similarities in [each company's] design philosophy and production methods that make this an excellent fit".

For example, all the aircraft feature no life-limit composite airframes "with failsafe and redundant design concepts". They are also produced using low temperature, out-of-autoclave

curing processes "for better field reparability", says Maurer.

The company's experience in producing similarly-sized structures for the defunct D-JET personal jet will "give us the experience and ability to complete this challenging task", he adds. Diamond mothballed the single-engined D-JET in 2013, after it failed to secure funding to complete development. Maurer has hinted at its relaunch as a twin-engined design.

Diamond has been contracted to manufacture 10 Seastar shipsets initially, with the option of producing additional units. The Canadian airframer says it will prepare the tooling in anticipation for higher volume production.

Work on the first aircraft is already under way, Diamond says, and the completed airframe will be delivered to Dornier's final assembly and completions facility in Oberpfaffenhofen, Germany, in the second quarter.

Dornier also plans to build another assembly line in China within two years, to cater for the Asian market. ■

ACQUISITION KATE SARSFIELD LONDON

Comlux signs up for trio of Airbus ACJ320neos

Swiss business aviation services provider Comlux has become the largest customer for the Airbus ACJ320neo following an order for three of the type – a corporate version of the re-engined A320neo.

The company, headquartered in Zurich, says the narrowbodies will be fitted with CFM International Leap-1A engines, with the first aircraft scheduled for delivery in 2018 to Comlux's US completion centre in Indianapolis.

Comlux is already one of the largest operators of ACJ320, with four of the VIP-configured type in its fleet. Its management and

charter arm also operates a further 16 aircraft, including an A330, Boeing BBJ777, BBJ767, a Sukhoi Superjet 100 business jet, an ultra-long-range Gulfstream G650 and three long-range Bombardier Global 6000s. In December 2014, 12-year-old Comlux placed its first order with Boeing for the purchase of two Leap-1B-powered BBJ Max 8s. The first 737 Max 8-based airliner is earmarked for delivery to Indianapolis in 2018.

Prior to the Comlux deal, Airbus had taken orders for five ACJ320neo-family jets, with Boeing having 10 BBJ Max orders. ■



Christian Keller/Airbus Helicopters

ROTORCRAFT

Körfez takes first Mercedes H145

Turkish operator Körfez Aviation has received the first Airbus Helicopters H145 with a Mercedes-Benz Style interior, after its October launch. The business aviation provider, part of the Dogus Group, has another example of the medium twin on order, due in March. Airbus Helicopters has taken five orders for the variant.

Developed for the earlier EC145 model, the Mercedes-Benz Style is tailored for high-end private and corporate operations. It offers a redesigned cabin interior with in-flight wi-fi connectivity, an improved infotainment system and a new ergonomic seat design.

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STRATEGY KATE SARSFIELD LONDON

Rise mulls European ascent

Membership-based business aircraft service targets EU for next stage of expansion plans

US membership-based operator Rise is evaluating the European market, with a view to launching a modified version of its scheduled business aircraft service on the continent.

Speaking on the sidelines of the Corporate Jet Investor conference in London on 1 February, Rise co-founder and chief operating officer Dan Caine said Europe could be the next step in its strategy to expand globally.

"It's early days," Caine says. "But Europe is an ideal market for a programme like Rise."

The venture was launched in the USA last year, offering its members an "all-you-can-fly", point-to-point scheduled service to four major cities in Texas, using a fleet of Beechcraft King Air 350s. The bespoke eight-seat, twin-engined turboprops are operated by Dallas-based Monarch Air. "We buy a large number of hours from them," says Caine. "This not only soaks up Monarch's under-utilised capacity, it also gives the operator a predictable and sustainable revenue stream. It's a win-win."

Rise is designed to give travellers an alternative to "expensive" ad hoc business aircraft charters, says Caine, and to offer a "far



The scheduled service operates using Monarch Air turboprops

better experience" than traditional airline travel, which he describes as "inconvenient, cramped and frustrating".

The Rise service is quick, regular, convenient, affordable and of a very high quality, says Caine. "We are simply bringing the benefits of private aircraft travel to the scheduled market. For a monthly membership fee [starting at \$1,700] our customers can fly as often as they like," he adds.

The company's ambition is to become a recognised brand in the air travel market. "We want to revolutionise global air travel the same way Uber and Airbnb have done to the car and hotel indus-

tries," he says. The service is already popular in Texas, so Rise is looking to expand across the USA.

"We have aggressive growth plans, both in the USA and worldwide," says Caine. Europe is likely to be the site of its first international operation.

"We don't have a timescale for a European launch, but we are studying the market hard," he adds. "There are plenty of secondary commercial airports close to major cities where we can fly to, and a number of good charter operators with under-utilised capacity that may welcome our business." ■

ACQUISITION

Global Jet eyes Latin growth on back of GE deal

Global Jet Capital has completed its acquisition of GE's fixed-wing corporate aircraft financing portfolio in the Americas and sees the potential for growth in Latin America.

The Boca Raton, Florida-based company was launched in 2014 by three investment firms to provide finance and leasing options to owners of mid- to VIP airliner-sized business jets.

Although the majority of the aircraft financed by the company are in North America, Global Jet says there are "strong signs of growth potential" further south.

Executive director Shawn Vick singles out Brazil and Mexico as countries with notable prospects. With inventories of 330 and 570 top-end business jets, respectively, including 30 aircraft financed by Global Jet, "these are well established markets with a good infrastructure", he says.

"[As] in many regions, sources of funding are reducing, so there is [a] significant opportunity for us to step in and provide financing solutions," says Vick – a business aircraft industry veteran and former senior executive with both Gulfstream and Hawker Beechcraft. ■

DELIVERY KATE SARSFIELD LONDON

Jackie Chan uses Legacy 500 to beat Rush Hour

Embraer has delivered the first China-based Legacy 500 to brand ambassador Jackie Chan.

The handover comes seven months after the midsize business jet secured Chinese certification and should help to raise awareness of the 10-seat, fly-by-wire aircraft in Asia.

Guan Dongyuan, president of Embraer China, says the actor's selection of the Legacy 500 is a boost for the midsize sector and could mark a cultural shift for a country renowned for its preference for large-cabin, long-range

business jets. "Chan's choice reflects a changing mindset among Chinese customers that midsize executive jets can fulfil their business missions," says Guan. Martial arts star Chan became the Chinese launch customer in 2012 for the large-cabin Legacy 650.

Flightglobal's Fleets Analyzer database records around 30 Legacy 500s in service, nearly half of which are in the USA. In 2015 – the twinjet's first full year of production – Embraer shipped 20 of the Honeywell HTF7500E-powered type. ■



Brand ambassador Chan with the Embraer midsize business jet

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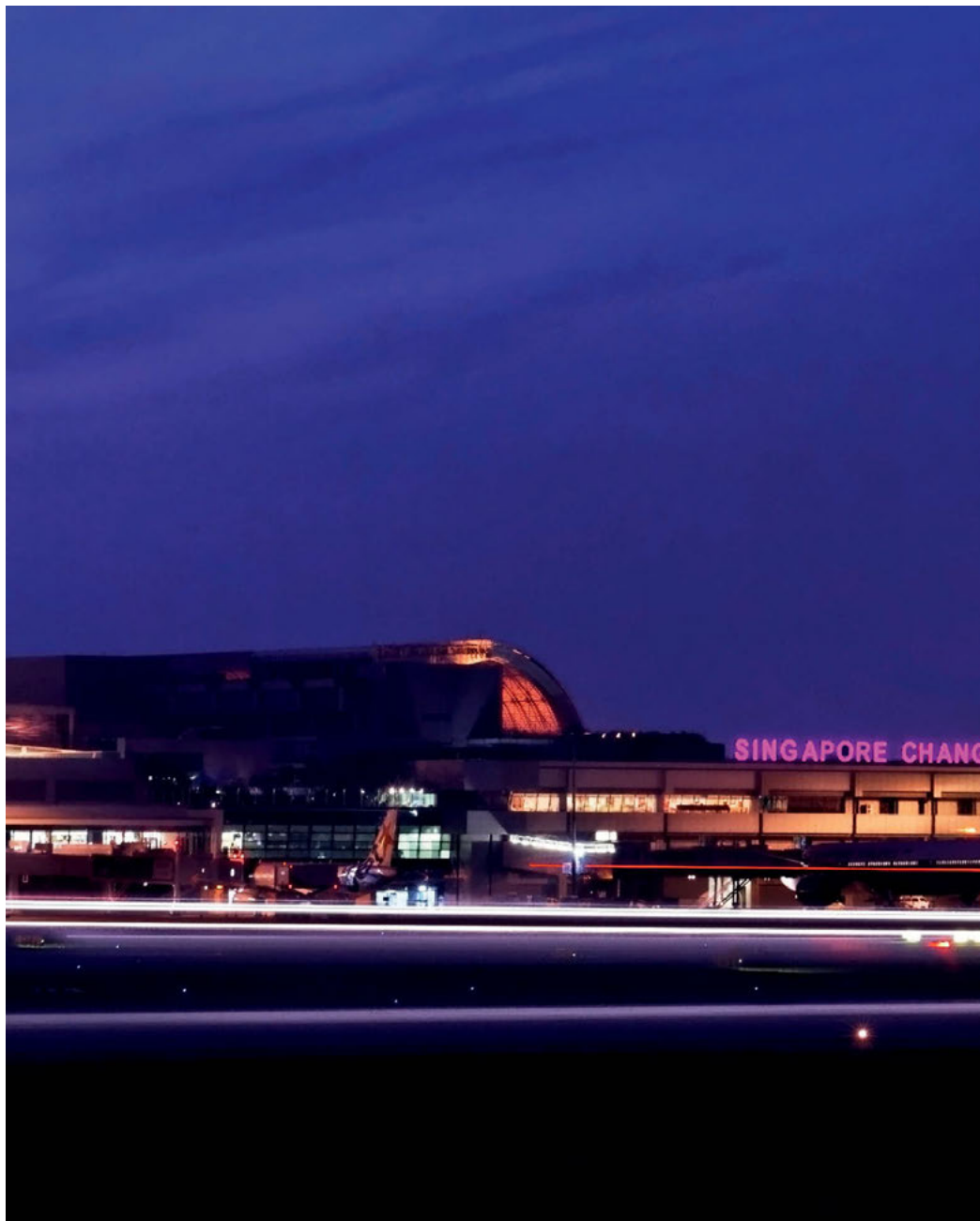
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CONTENTS

- 42 **Air force** Responding to China
- 45 **Super Puma** Scramble for renewal
- 48 **Civil rotorcraft** Offshore in doldrums
- 50 **Indonesia's N219** Turboprop ambitions
- 53 **Seletar** A focus for aerospace
- 54 **Changi airport** Proud new arrivals
- 56 **ASEAN open skies** Lacking agreement

It may be a tiny city-state surrounded by enormous neighbours, but Singapore nevertheless packs a special punch when it comes to aviation. Its air force, already arguably the most potent in the region, is gearing up for some major upgrades to stay abreast of the country's evolving geopolitical challenges. Its geographical location gives it a key role in regional sea patrol and rescue. And, in a broader region where economies and civil air travel are booming, Singapore's Changi airport is a hub of virtually unmatched significance, both for intra-Southeast Asian traffic and connections to Europe, Africa and the Middle East. Maintenance, too, figures increasingly in a growing aerospace industry. On the eve of the 16-21 February Singapore air show, a special report from Flight's Singapore bureau



SING THE PRAISES OF AEROSPACE



Changi airport



Xinhua/REX/Shutterstock, Shorrey, Seletar Aerospace Park

Changi airport is a gleaming hub – with plans for an even brighter future. F-16s from the air force's Black Knights team put on a show of air authority; offshore oil and rescue helicopter sales face daunting challenges; and Seletar shows the way for new industry cluster

DETERRENTS

Responding to China

Southeast Asia's leading air force continues to methodically improve its already impressive fixed-wing inventory

GREG WALDRON SINGAPORE

On 9 August 2015, the Republic of Singapore Air Force (RSAF) conducted probably its most important mission: flying an armada of fighters, helicopters, transport aircraft and more over downtown Singapore to celebrate the nation's 50th anniversary. The highlight was a fleet of 20 Lockheed Martin F-16C/Ds flying in a "50" formation. The final touch was a lone Boeing F-15SG performing a tight turn over Marina Bay reservoir, afterburners roaring.

Fun aside, the RSAF has been setting the stage for future capabilities since the last iteration of the Singapore air show, in 2014. This period has seen the regional situation become more tense. China has become more assertive about pressing claims to the South China Sea, putting it at loggerheads with the city state's Southeast Asian neighbours Malaysia, Vietnam, Indonesia and the Philippines.

GEOPOLITICAL UNCERTAINTY

Two other key Singapore allies, the United States and Australia, are concerned about China's belligerence. Not to say a conflict is imminent – Singapore and Beijing enjoy close ties – but mounting geopolitical uncertainty underlines the need for the robust deterrent of the RSAF and its sister services.

The most significant news to emerge since the last Singapore gathering is the March 2014 announcement Singapore will take six Airbus



The Republic of Singapore Air Force's F-16 fleet has a more serious duty to perform than just ceremonial displays from its Black Knights

A330 multi-role tanker transports (MRTT). Singapore's interest had been rumoured for years. Observers say its four 1960s Boeing KC-135Rs are maintenance intensive.

Given Singapore's use of the F-16 and F-15SG, which require a boom for air-to-air refuelling, the country is to obtain its MRTTs in a configuration similar to those used by the Royal Australian Air Force (RAAF), which also includes a hose and drogue refuelling pod under each wing. The boom will support types including a potential Singaporean fleet of Lockheed F-35s. RAAF officials have said Singapore was eager for Australia to get the boom on its A330 MRTTs operational. A fact

sheet by Singapore's defence ministry reveals the nation's aircraft will be powered by Rolls-Royce Trent 772B engines and delivered with a 266-seat passenger cabin. Airbus Defence & Space will perform conversion work in Spain.

"The Singapore A330 MRTTs will be converted in Madrid," the airframer tells *Flight International*. "The expertise and efficiencies that the company has accumulated in this complex conversion mean that this is clearly the most effective solution."

Analysts are positive about the tankers.

"The six new A330s will provide the RSAF with a more modern and capable aerial refuelling platform than its four KC-135R Stratotankers and a niche complement to its Lockheed KC-130B/H tactical transport/refuelling aircraft once they begin to arrive in 2018," says Forecast International analyst Dan Darling. "The A330's dual-use gives Singapore additional troop transport capability in a pinch, but more importantly to maximise its aerial combat capability by providing for longer loitering and patrol missions for its fighter aircraft through their refuelling."

The last two years also saw Singapore clarify upgrade plans for its 60 F-16s. Avionics will be upgraded by Lockheed, and the aircraft will gain an active electronically scanned array (AESA) sensor in Northrop Grumman's scalable agile beam radar.

At the 2014 show, BAE Systems and Raytheon mounted a public relations effort for their F-16 upgrade offerings, in the hope of a



Secrecy shrouds the exact strength of city state's fleet of F-15SG strike aircraft

competitive tender. The pair were riding high. In late 2013 Raytheon had defeated Lockheed to upgrade the avionics of South Korea's F-16s, and Raytheon had won the parallel AESA radar competition. It is not clear if their calls for a tender made an impression on Singapore officials, but now the case is moot. In early December, more news about the upgrade programme emerged, with the US Department of Defense announcing Lockheed has been awarded a \$914 million contract via the Foreign Military Sales mechanism, to upgrade the F-16s. It offered few details, but indicated the work will take place in Fort Worth, Texas, and could be completed by June 2023.

Meanwhile, BAE and Seoul had a dispute over the price of the upgrades, which led to cancellation of the programme and litigation. Eventually the Lockheed/Northrop team won. The pair also have a programme to upgrade Taiwan's F-16s.

It is not clear how many Singaporean F-16s will be upgraded. In May 2015, the US Defense Security Cooperation Agency published a revised list of equipment related to the project, including 50 Boeing joint helmet-mounted cueing systems (JHMCS), 90 BAE APX-126 advanced identification friend and foe (IFF) interrogator/transponders, and 92 Link 16 terminals.

The number of JHMCS sets and IFF transponders in the list varied from a previous one, issued in early 2014. That approval called for 70 JHMCS sets; 20 more than in the revised document. The initial requirement also called for 70 APX-125 IFF transponders – the revised list increasing the number by 20 IFF units – and calling for a different standard: the APX-126.

Another uncertainty concerns where the work will be done. It is possible, probable even, a significant amount may end up at local maintenance, repair and overhaul firm ST Aerospace, which has notable expertise with fighters. A local solution would mirror the South Korean upgrade programme.

In the 1990s, ST Aero oversaw a major – and by all accounts successful – upgrade for Singapore's former fleet of Douglas A-4S Skyhawks to an A-4SU standard. This saw the venerable type's Pratt & Whitney J52 engines replaced with a non-afterburning General Electric F404. Though Singapore retired the Skyhawk from its combat role in 2005, ST Aero is involved with MRO work related to the nation's Northrop F-5S fighters, as well as the F-16s.

The most interesting question about the RSAF involves its F-15SG fleet. Boeing and the government maintain the number is 24, but outside observers have long suspected the true number is higher, perhaps up to 40 divided between Singapore's Paya Lebar air base and the US Air Force's Mountain Home

AFB in Idaho, where a training detachment is stationed. On 6 August 2014, the US Federal Aviation Administration registry showed eight F-15SG aircraft registered to Boeing. The aircraft bear registrations N361SG, N363SG, N366SG, N368SG, N373SG, N376SG, N378SG and N837SG. Industry observers had already estimated the true number was probably 32 not 24, mainly owing to the range of registration numbers on Singapore air force-registered F-15SGs.

On a tour of Korea Aerospace Industries' (KAI) Sachon factory in 2011, *Flight International* observed the forward fuselage assembly of an F-15 labelled "SG28" – KAI is a key contractor in the F-15 programme.

"The new A330s will provide the RSAF with a more capable aerial refuelling platform"

DAN DARLING

Analyst, Forecast International

Cloaking one's order of battle in ambiguity is nothing new in the annals of military history. "The benefits of hiding F-15SG numbers for Singapore apply to its strategic calculus that it is better to keep potential state-based threats guessing," says Forecast International's Darling. "Singapore's power-projection approach to national security strategy dictates first-strike/force-multiplier capability is crucial – and deterrence more so. Any enemy who is aware Singapore has high-quality capabilities and a well-trained force, but is unsure of the critical mass it is capable of bringing to bear, is a tentative enemy."

LIGHTNING STRIKE

Singapore's fighter fleet is rounded out by 26 well-maintained but ageing F-5S fighters, which date from the earliest days of its air force, in the 1970s. The type has been extensively upgraded, but its looming retirement is a foregone conclusion. It is all but certain the fleet will be replaced by the F-35. For years Lockheed has displayed a mock-up of the F-35

at the Singapore air show in RSAF markings. The city-state is a security co-operation participant in the programme, giving it access to programme data and allowing it to request special studies. In March 2013, defence minister Ng Eng Hen said an evaluation of the F-35 was almost complete.

"For the longer term, the Republic of Singapore Air Force has identified the F-35 as a suitable aircraft to further modernise our fighter fleet," said Ng in 2013.

Local media reports last December quoted Ng as saying Singapore is in "no hurry" to make a decision to obtain the F-35, and is evaluating the type. Ng made the more recent comments on a visit to Luke AFB in Arizona.

"Two years ago when we were here, these hangars were not filled (with F-35s)... within 18 months they've clocked in more than 3,000 sorties, 5,000 hours – that's a lot of flying," said Ng. "And that gives us confidence the programme is on track. So the more mature the programme is, the more steady the production lines for [the F-35s], the more boxes are ticked when we evaluate it. But we are in no hurry to decide."

Richard Bitzinger, senior fellow at Singapore's S. Rajaratnam School of International Studies, says Singapore is just being careful. "The F-35B makes sense to a country with only a few bases and few options for dispersed operations," he says. "Ostensibly, Singapore could set up austere basing sites for the B version, including islands off the mainland. Singapore is probably just being prudent, and waiting until the F-35B goes through its teething with the US military. They'll probably announce any F-35B acquisitions the same time they place an order for the A version."

LACK OF LAND

Bitzinger touches on one of the key questions surrounding Singapore's plan to obtain the F-35: the mix of conventional take-off and landing F-35As and short take-off and vertical landing (STOVL) F-35Bs. A major challenge facing Singapore's air force – and the other arms of its military – is the chronic shortage of »

Six boom-equipped A330s will be fielded





AEW-roled G550 is one of air force's newest assets, while KC-135Rs are set to retire

» land in the densely populated nation.

For the time being, the air force enjoys usage of Paya Lebar air base, a single runway facility that was Singapore's international airport until Changi International airport opened in 1981. Unfortunately, Paya Lebar rests on extremely valuable real estate in the centre of the crowded island. Apart from the land occupied by the base itself, aircraft movements limit construction heights in nearby areas.

Long term plans call for the closure and redevelopment of Paya Lebar, and the conversion of the existing air force runway at Changi East to a commercial runway. A new airbase will be built on reclaimed land in Changi farther to the east of the existing airport, effectively replacing both Paya Lebar and the Changi East base with one, single site. This will leave Singapore with just two bases earmarked for fast jets: Tengah in the nation's west and the new Changi base.

Although Singapore's civilian runways can be given over to military use in a crisis – and several public roads are designed to serve as runways in an emergency – it is an inescapable fact the Singapore air force has limited basing options. As such, the flexible basing capability offered by the F-35B will have clear attractions for Singapore.

Forecast International's Darling says Singapore's caution about the F-35B probably stems more from cost than concerns about the jet itself.

"The long-term funding of such an expensive acquisition is no doubt a key factor in its hesitation to announce its commitment to the pricy F-35B as of yet," he says. "Balancing costs within the defence budget with an ongoing government campaign to bolster the living standards of citizens is no doubt a consideration. The hope for Singapore is that, over time, unit prices per F-35B aircraft will

decline, thus ensuring a more cost-effective purchase in the future."

UNMANNED PROGRESS

Singapore has also been active bolstering its unmanned capabilities. In April 2015, the Elbit Systems Hermes 450 unmanned air vehicle fleet reached full operational capability (FOC), some eight years after the system was delivered to the RSAF. Following the delivery of the UAV to its 116 Sqn in May 2007, pilots, engineers and maintenance crews underwent "intensive training" to allow them to operate the aircraft in line with RSAF procedures, said the Singapore defence ministry at the time the FOC was granted.

The Hermes 450 was acquired to supplement the air force's Israel Aerospace Industries Searcher and Heron 1 UAVs by providing a vehicle with longer endurance, advanced avionics and better sensors. Key to this is the three-in-one payload, which combines electro-optical, forward-looking infrared and a laser designator in one pod.

"This enables the H-450 to augment our battlefield surveillance capabilities by

conducting a wide array of missions, such as target acquisition and designation, reconnaissance and battle damage assessment," said the ministry. The Hermes 450, however, may not mark the ultimate limit of Singapore's high-end UAV capabilities. Although it is never publicly discussed, the RSAF is understood to be interested in the Northrop RQ-4 Global Hawk. Indeed, Northrop executives gave a media briefing about the system at the last Singapore air show.

Deployed in international airspace at the northern end of the Straits of Malacca and above the South China Sea, the Global Hawk, or its Triton maritime patrol variant, would provide the RSAF unprecedented and persistent situational awareness of the region. It is not clear, however, how interested the RSAF is in such a platform, or whether Washington would view the introduction of such a capability into Southeast Asia as destabilising. At this year's show it will be interesting to see if Northrop again comes prepared to discuss the Global Hawk family.

EARLY WARNING

The RSAF's key command and control capability resides in its four Gulfstream G550 airborne early warning and control system aircraft, which became fully operational in April 2012. These replaced the country's four E-2C Hawkeyes, which had served since the 1980s. Singapore's G550s have a similar configuration to the conformal airborne early warning platform operated by the Israeli air force.

Israel Aerospace Industries subsidiary Elta Systems says this offers a mission endurance of 9h when operating at an altitude of 41,000ft and 100nm (185km) from its home base. The aircraft features dual S-band radar arrays at the front and rear, plus L-band sensors on the fuselage side, providing 360° coverage. Israel's configuration has six on-board operator stations. The modified G550 also has pod-housed electronic support measures equipment, plus satellite communications and line-of-sight data links. Elta says the airframe



Lockheed won the F-16 upgrade contract

modifications have “minimal impact” on the business jet’s performance.

Singapore also operates five Fokker 50 maritime patrol aircraft (MPA). These are very capable platforms, and have been deployed to the Gulf of Aden for coalition anti-piracy work. Nonetheless, Singapore has explored the possibility of obtaining former US Navy Lockheed P-3C Orions.

“Singapore’s armed forces are well-equipped to deal with any local threats”

RICHARD BITZINGER

Snr fellow, S Rajaratnam School of International Studies

Singapore has been mooted as possible customer for the Boeing P-8A Poseidon, but observers feel this type is above specification for routine patrol work near its shores. Nonetheless, Singapore’s MPA capabilities had a boost when the government approved USN P-8As to operate from Singapore. Periodic deployments will improve US surveillance over Chinese activities in the South China Sea, and should presumably give a boost to Singapore’s situational awareness.

Rounding out the RSAF are 10 C-130H tactical transports, a common sight in Singapore skies. Apart from routine transport, these have served in overseas disaster relief missions, and participated in searches for missing aircraft, namely MH370, a Malaysia Airlines Boeing 777 that disappeared in March 2014, and QZ8501, an Indonesia AirAsia Airbus A320 that crashed into the Java Sea in December 2014.

Flightglobal’s Fleets Analyzer database shows the average age of Singapore’s C-130s is 43 years, with the youngest 29.2 years old, and the oldest 56.4 years. It is probable Singapore will seek a replacement for these aircraft in the medium term. Potential replacements could include the C-130J, Airbus A400M, or even the Embraer KC-390.

“Singapore’s armed forces are well-equipped to deal with any local threats,” says Bitzinger.

“With the purchase of up to 100 F-35s, it will continue to be so well into the middle of the century. The challenge is China. If China becomes more militarily present in the South China Sea, and more aggressive in using force to back up its claims, that could present a latent, long-term threat to Singapore that it would find hard to compete with. China can simply bring much more force – qualitatively as well as quantitatively – to bear against Singapore or any other Southeast Asian military. Hence the increasing need to hedge against China by inviting the US into a closer embrace, militarily speaking.” ■

The nation’s Super Puma fleet needs replacing



PROCUREMENT

Scramble for renewal

With speculation mounting that a helicopter replacement scheme is in the offing, manufacturers will turn out in force at biennial show

GREG WALDRON SINGAPORE

The Republic of Singapore Air Force (RSAF) is unusual in operating the vertical lift assets used by sister services, the army and navy. That said, Singapore’s realistic approach to defence procurement means helicopter assets are not neglected. Indeed, one of Singapore’s biggest requirements concerns the replacement of its Airbus Helicopters AS332/532 Super Pumas/Cougars.

Flightglobal’s Fleets Analyzer database shows the RSAF operates 76 helicopters, of four types. The army fleet comprises 32 Super Pumas in the troop transport/utility role, 16 Boeing CH-47SD Chinooks, and 17 Boeing AH-64D attack helicopters. Singapore also has six Sikorsky S-70B helicopters for naval missions including anti-submarine warfare and anti-surface warfare.

It has two S-70Bs on order, but their configuration has yet to be announced. There are also five Airbus Helicopters H120s for training.

At this year’s Singapore air show, a key focus will be the Super Puma replacement. Some observers speculate this programme has been in play for nearly a decade, although Singapore’s secretive defence establishment has said little publicly. News that Singapore will replace aircraft which have served for nearly 30 years came in March 2015, when defence minister Ng Eng Hen told the country’s parliament re-

placements are necessary and “this will occur over the next decade.” Ng made no mention of how many airframes will be obtained, but any initial order for new helicopters is likely to be for 20 or fewer. A subsequent order could see the Super Pumas replaced one-for-one, but Singapore has never stated its intentions.

MAINTENANCE BURDEN

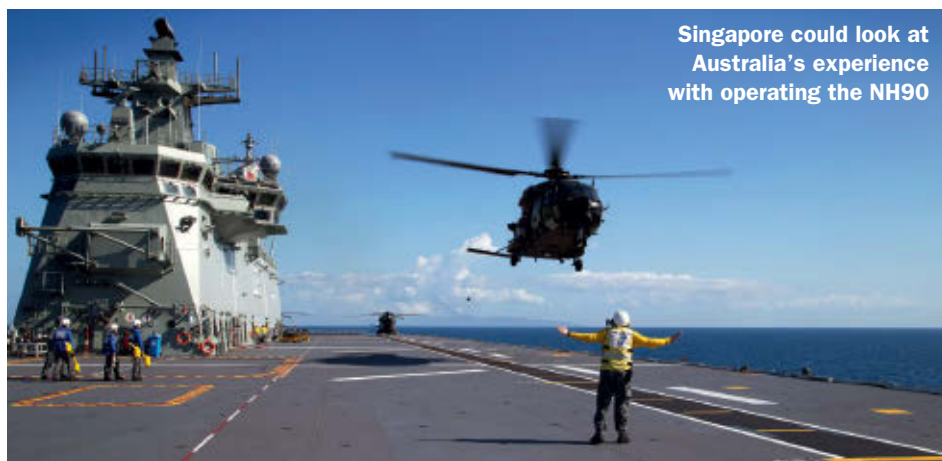
Fleets Analyzer shows the average age of the fleet is 27 years, with the oldest aircraft 31 years old and the youngest 24. Although Singapore’s Super Pumas are very well maintained, industry observers say the airframes probably impose a substantial maintenance burden, particularly given Singapore’s hot, humid climate and high utilisation rates. A newer, more maintenance-friendly aircraft would allow the country to operate fewer airframes.

Major helicopter manufacturers are, naturally, interested, but decline to provide details, citing customer sensitivities. Nonetheless, it appears Singapore could be interested in replacing its Super Pumas, which have a maximum takeoff weight (MTOW) of roughly 8.6t, with a larger and more capable aircraft, perhaps featuring a rear ramp.

“Singapore’s Super Puma replacement will be weighed with these factors in mind: ease of maintenance, hot weather capability and durability and payload if a unit-for-unit replacement is not the preferred route,” says Forecast International analyst Dan Darling.

Other observers feel ease-of-maintenance will rank highly. As a small nation with limited human capital, the fewer personnel required to maintain aircraft the better. In the naval regime, Singapore has tended to highlight how newer warships require smaller crews. A consistent theme in military communications is doing more with fewer personnel, and leveraging technology.

At the 2014 show, Bell Boeing promoted the V-22 Osprey tiltrotor. The type appeared on



Singapore could look at Australia's experience with operating the NH90

static and in the flying display, with activities including a flight for journalists. The Osprey, with its MTOW of 21.5t and ability to fly long ranges at high speed, would probably be too capable (not to mention costly) for the general utility and transport missions undertaken by Singapore's Super Pumas. Were Singapore to obtain the Osprey, it would probably be in small numbers for use by special operations forces.

In US Marine Corps service, the Osprey has proven its usefulness in humanitarian relief operations. This could be a consideration, because Singapore prides itself on timely disaster relief in neighbouring countries.

"The [NH90] has a lot of potential [and is a] great helicopter to fly"

REAR ADM TERRY DALTON

Head of helicopters, Australian DMO

Other types that could be in the running include the Sikorsky S-92 and NH Industries NH90. Sikorsky has never discussed what, if anything, it is offering for the Super Puma replacement, but at the IMDEX Asia 2015 naval show in Singapore it displayed a model of the S-92 equipped for combat search and rescue. With a MTOW of 12t, the type is considerably larger than the Super Puma. One challenge with it is that despite its success as an offshore support helicopter for the oil sector, it has not achieved popularity as a combat helicopter.

THE AIRBUS HELICOPTERS EDGE

The NH90 is marketed in the region by Airbus Helicopters, which has a large maintenance, repair and overhaul hangar at Singapore's Seletar airfield. Through the company's support of the Super Puma fleet, it has probably developed a strong network in Singapore's defence establishment. This may have served it well at the requirement definition stage and helped it devise a bid tailored to RSAF issues.

Like the Osprey and S-92, the NH90 has a ramp. Its MTOW of 10.6t is closer to that of the 8.6t Super Pumas, and another possible benefit is that two of Singapore's key military allies in the region, Australia and New Zealand, operate variants of it – the type is designated MRH90 in Australian service. Land-scarce Singapore has a permanent training mission in Australia, so helicopter commonality could be an attraction. Another compelling argument for the NH90 could be its ability to operate from land and warships. Australia plans to operate its MRH90s from the decks of its two new Canberra-class landing helicopter dock (LHD) vessels. Singapore has operated its Super Pumas from the decks of its amphibious assault ships, and even deployed the capability as far afield as the Gulf of Aden in support of international anti-piracy efforts.

Moreover, there is evidence Singapore could be contemplating its own LHD. At local defence shows over the last few years, Singapore shipbuilder ST Marine displayed a model of a flat top designated the Endurance 160. The 164m (540ft)-long vessel would have an aircraft carrier-style flight deck capable of accommodating five helicopters, with a hangar below for four. Such a warship would not only be capable of handling aircraft the size of the NH90 and S-92, but also Singapore's Chinooks.

Another Apache operator – the British Army – has successfully operated its attack helicopters at sea.

That said, Australia's experience with the NH90 could also cut the other way for Singapore, which prefers to buy proven, low-risk defence solutions after review and reflection. In September, Royal Australian Navy Rear Adm Terry Dalton, head of helicopters with the Australian Defence Materiel Organisation, warned NH Industries it must continue to rein in the scope of its NH90 helicopter programme "towards a more manageable number of versions" for the rotorcraft to be "truly a success."

Of the several NH90 customers bearing the scars from a painful development process that resulted in a 10-year delay, Canberra's procurement of a planned fleet of 46 helicopters was one of the most painful. The programme is five years behind schedule, and is likely to slip by a further 24 months, said Dalton.

Although Dalton says the "aircraft has a lot of potential" and is a "great helicopter to fly" – as well as conceding a number of issues such as floor and windscreen cracking have been resolved – Australia's fleet still lacks fast-roping capability and door guns – "all those things that make a helicopter a military asset."

If Singapore goes with a larger helicopter such as the NH90 or S-92, as appears likely, it will have a lopsided helicopter fleet, dominated by large, heavy-lift types. Fleets Analyzer shows it has nothing in the mid-sized or light utility categories. It is not clear if a requirement for a smaller type will emerge, although it could make sense to have a model such as the Bell Helicopter OH-58D to support the Apaches, or even a small fleet of utility helicopters, which could also support special forces.

Irrespective of what Singapore eventually decides, helicopter makers will be out in force at this year's show. With tight defence budgets at home, being selected to fill Singapore's helicopter requirements would be a major win. ■

Additional reporting by Dominic Perry in London



A new class of maritime vessel could potentially accommodate the CH-47SD Chinook

STRONGER TOGETHER



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MARKETS

Offshore in doldrums

Helicopter makers are looking for new opportunities across Southeast Asia, amid weakness in the oil and resources sector

GREG WALDRON SINGAPORE

Passengers landing at Changi International airport in 2015 were treated to a view highlighting the challenges facing big helicopter manufacturers in Southeast Asia. Out in the Johore Strait between the city state and Malaysia sat a long row of idle oil rigs, helipads empty. They are a potent symbol of how the oil price crash in the last 24 months has transformed the helicopter market.

Manufacturers like to discuss opportunities in areas like emergency medical services (EMS), VIP transport, and police work, but there is no escaping times are tough. It is difficult to imagine how the region's nascent EMS and VIP/business markets will take up the slack from weakness in the oil and resources sectors.

Flightglobal's Fleets Analyzer database lists the countries of the Association of Southeast Asian Nations (ASEAN) as having an in-service civilian/parapublic helicopter fleet of around 635 aircraft. There are firm orders for 56 helicopters, and 35 in storage. Of the in-service fleet, 144 serve in the specialised offshore/oil and gas role. There are 137 for business use, 31 for VIP/head of state missions, 19 for EMS, and two for fire fighting. A further 211 are deployed in the utility mission, but many of these serve in the resources sector, particularly in Indonesia. Police forces in Thailand, Indonesia and Malaysia are big users of helicopters, with 81 aircraft.

A research report from oil and gas trade publisher Rigzone says 2015 was a year to forget for the industry, and 2016 could be worse. It notes the price of Brent crude fell by 43% in 2015, and utilisation for rigs fell



Manufacturers including Sikorsky are seeking opportunities in segments away from oil and gas, such as search and rescue, VIP transport and emergency medical services

sharply in 2015. "In summary, 2016 is likely to be a survival year for those companies that operate in the offshore rig arena," it says.

Fewer operational rigs and tough times at oil companies are anathema to the helicopter operators tasked with transporting personnel.

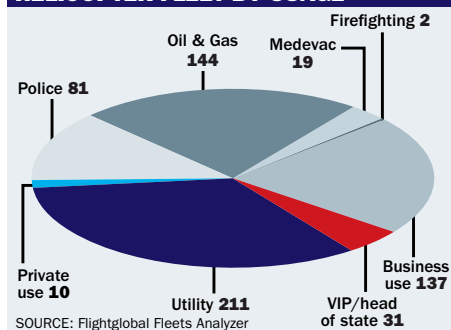
TOUGH TIMES

"We continue to monitor the situation closely," says Christophe Nurit, Sikorsky's regional sales director for Asia. "Sikorsky and every other helicopter OEM selling helicopters for offshore oil transportation are affected by the low price of oil and the increase in idle aircraft. Yet even with some aircraft removed from service, the percentage of flight hours for the S-92 helicopter fleet operating in this segment has been rising in the low single digits year over year, which we view as an encouraging sign of strong operator confidence in the aircraft."

The issue for manufacturers is that the energy sector collapse coincides with the introduction of advanced helicopters designed when oil prices were above \$100 per barrel. High prices justified oil platforms in deep waters, hundreds of kilometres from shore. Types such as the Airbus Helicopters H175, Bell Helicopter 525 Relentless and AgustaWestland AW189 were designed for this – and have seen the justification for their existence disappear.

Philippe Monteux, senior vice-president of Airbus Helicopters in the region, is gloomy about the offshore market. "[For 2015] we had zero bookings in this region for the oil and gas market," he says. "Not only the H225, but also

ASEAN CIVILIAN/PARAPUBLIC HELICOPTER FLEET BY USAGE



the H175. We booked some helicopters through big operators such as Bond or CHC, who have made the acquisition of some aircraft, but in general they book aircraft from a global point of view. They are not yet allocating aircraft to a specific region. It might well be the aircraft come to the region, but not Southeast Asia per se."

Fleets Analyzer shows the biggest operator of offshore helicopters in the region is Malaysia's Weststar Aviation, with 23 – 20 AW139s, an AW189, and two Sikorsky S-76s. Other big operators include fellow Malaysian outfit, MHS Aviation, with 18 helicopters, and Indonesia's Pelita Air Services and Traviara Air, with 14 each.

Sikorsky is the lead player in the ASEAN offshore market, with 45 aircraft in service. These comprise 40 S-76s, four S-92s, and an S-61. AgustaWestland has 43 offshore helicopters in the region, Airbus Helicopters 33, and Bell Helicopter 20.



The H130 is among types in current use



missions, and that installed base creates training requirements. So even though the acquisition of new aircraft has slowed, aircrews operating existing fleets continue to utilise our simulation-based training centres as a cost-effective way for them to stay current.”

COMMERCIAL SHOW

Singapore air show organiser Experia Events recently launched a specialised show for the commercial helicopter sector. The first iteration of Rotorcraft Asia will be held from 18-20 April 2017. The events company has letters of intent from major companies to participate, including Airbus Helicopters, Bell, Honeywell, StandardAero and Turbomeca.

Helicopter executives *Flight International* spoke with are optimistic about other sectors in the Southeast Asian market, namely VIP transport and EMS, although several issues limit growth in both areas.

Fleets Analyzer shows just 31 helicopters dedicated to VIP transport in Southeast Asia. Tellingly, all are operated by governments. A fleet of 10 privately-owned helicopters are mainly single-engined types produced by Robinson. Some helicopters listed as utility types are also probably used to carry rich individuals, but Southeast Asia can be a challenging place for a private operator seeking to take advantage of a helicopter’s flexibility. Airbus Helicopters, for example, recently treated journalists to a media flight from Seletar airport aboard an H145 T2. For a 10min ride around the airport, the passengers had to go through an airport-style screening process, adding time and hassle. The aircraft was not allowed to depart directly from its parking spot on the apron, but was obliged to hover-taxi feet above the ground and then take off along the runway. Regulations are similar in Thailand.

CM Hwang, managing partner of leasing startup Aeroinfinity and a former executive at Bell, says a helicopter on board a super yacht cannot take off from the ship in Singapore waters and fly to a local airport. Instead, the yacht must be in international waters.

Such restrictions abound. Malaysia is viewed as among the most helicopter-friendly countries, but nations such as Singapore, Thailand and Vietnam are more restrictive.

Growth in EMS could be even more challenging. The greater Southeast Asian region has half a billion people, served by 19 EMS helicopters. In theory this presents a growth opportunity, but flight restrictions get in the way. The concept of a helicopter taking off from a hospital, landing on a highway and taking onboard a casualty is all but unthinkable. “A helicopter that has to wait on the ground for clearance is not an EMS helicopter,” says Sameer Rehman, managing director for Asia Pacific at Bell. “This doesn’t take into account the urgency of the situation.” Nonethe-

“Market conditions have forced customers to make major fleet adjustments”

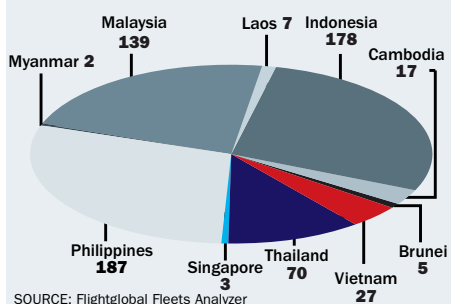
PETER REDMAN
Executive, CAE

less, Rehman is optimistic about EMS helicopters in Thailand, Indonesia and the Philippines. The challenge he sees – and this is echoed by other industry executives – is how the service is ultimately paid for. In Europe, taxpayers fund high quality EMS services, in the USA insurance pays and Australia uses a not-for-profit model.

Irrespective of the challenges around the oil and gas, VIP, and EMS sectors, one potential area of opportunity helicopter makers point to is the replacement of rotorcraft now serving in the utility role. Fleets Analyzer shows the average age of Southeast Asia’s 223 in-service utility helicopters is 21.4 years. The region has a large fleet of MD Helicopters MD369s, Bell 206s, and Airbus Helicopters H350s that are over 30 years of age.

Southeast Asia has come to a crossroads in the use of helicopters. Traditionally, demand for rotorcraft has been driven by the region’s booming oil and resources sectors. Given changes in these key markets, however, it is incumbent on manufacturers to further diversify into civilian and parapublic areas. To a large degree this will depend on their ability to educate the region’s governments about the broader benefits of civilian helicopter usage. ■

ASEAN CIVILIAN/PARAPUBLIC HELICOPTER FLEET BY COUNTRY



One veteran industry observer says he has never seen the offshore helicopter market this bad. Manufacturers say operators have reduced utilisation rates by 20-30%, but he says the true number is more like 50% from early 2015. Apparently, helicopter lessors have slashed rates to keep their fleet in service. “I don’t understand how they can be profitable,” he says.

But there is some positive activity. Last October, simulator firm CAE said a facility it set up with the government of Brunei had received European Aviation Safety Agency certification as an approved training organisation. A key focus of the centre is the S-92, of which Brunei Shell Petroleum operates two.

“There is no question market conditions have forced offshore oil and gas customers to make major fleet and aircrew staffing adjustments,” says CAE executive Peter Redman.

“However, there is still a sizeable installed base of helicopters in the region used for offshore oil rig and search and rescue support



A Bell 429WLG operating in Cambodia

MANUFACTURERS

Turboprop ambitions

Indonesia's state-owned airframer is bidding to bring back the nation's lost engineering skills with plans for a commuter type

FIRDAUS HASHIM SINGAPORE

Indonesian Aerospace (IAe) is determined to make a name for itself in the turboprop market, through development of a commuter aircraft called the N219 and a commercial variant of the Airbus Defence & Space CN235 medium transport.

The state-owned airframer, also known as Dirgantara Indonesia, held a roll-out ceremony for the N219 on 10 December 2015. The event was well attended by senior political figures, reflecting strong support for the project.

IAe plans to start a three-year certification test campaign in the first quarter of 2016 using four prototypes, it says in an email to *Flight International*. To date, it has built two of these. Static tests will begin this month, with flight tests to follow three months later. Apart from securing Indonesian type certification for the N219, it also hopes to obtain

certification from the US Federal Aviation Administration or European Aviation Safety Agency. The N219 will be capable of operating in a number of commercial, military, and parapublic roles. Missions include scheduled and chartered airline operations for up to 19 passengers, troop transport, search and rescue, cargo, and maritime surveillance.

Flightglobal's Fleets Analyzer database indicates that the Cessna Caravan and Grand Caravan are the most numerous aircraft types in Indonesia, with 69 examples in service, followed by the Pilatus PC-6 (21 aircraft) and DHC-6 Twin Otter Series 300 (15 examples).

Other older types still serving in Indonesia include the Shorts 330, Britten-Norman BN-2 Islanders and Fairchild Dornier 228. These range from 29 to 39 years of age.

REPLACEMENT MARKET

Edwin Soedarmo is chief executive of Indonesian aviation consultancy CSE Aviation, and a former president director at IAe. He thinks that the N219 has a bright future in Indonesia, as the aircraft is well placed to replace these legacy types.

He cites a CSE study that shows air connectivity in Indonesia is split into three types: hub-to-hub, hub-to-spoke and point-to-point flights.

"This [point-to-point] segment is a growing market as the consequence of [Jakarta's] decentralisation of authority to the provin-

"Direct flights, with no stopover, would [yield promising] revenue"

EDWIN SOEDARMO

Chief executive, CSE Aviation

cial and regency-level governments," explains Soedarmo.

"Direct flights, with no stopover at any big cities or an inter-province flight, would [yield promising] revenue for operators, which at present are served on a limited basis, and mostly flown by very old airplanes such as IAe NC212-100 and -200, as well as and DHC-6 Twin Otter Series 300."

The CSE Aviation study also indicates Indonesia has a potential market requirement of seven to 10 commuter aircraft in each of its 34 provinces over five years, for a total of 238 to 340 aircraft.

PROPOSED UPGRADE

While the N219 will compete with similar aircraft of its class, such as the NC212-400 (a proposed upgrade of the venerable C212-400), Grand Caravan, as well as Viking DHC-6 Twin Otter Series 400, Soedarmo is confident of its prospects. He says the N219 is designed for geographical challenges in Indonesia, where remote regions have minimal infrastructure at air strips, often with runways of less than 600m in length.

COMMUTER AIRCRAFT OPERATING IN INDONESIA*

	In service	Average age
Beechcraft King Air 350	4	2
de Havilland Canada DHC-6 Twin Otter Series 300	15	39
Britten-Norman BN-2 Islander	2	29
Britten-Norman BN-2 Trilander	2	22
Cessna Caravan	8	14
Cessna Grand Caravan	54	8
Cessna Grand Caravan EX	7	2
Fairchild Dornier 228	1	29
Hawker Beechcraft 1900D	6	17
Hawker Beechcraft King Air 350	1	8
Hawker Beechcraft King Air 350i	1	4
Indonesian Aerospace C212	1	25
Pacific Aero 750XL	5	6
Piaggio P180 Avanti	3	6
Pilatus PC-6	21	14
Pilatus PC-12	1	9
Shorts 330-200	1	36
Viking Air DHC-6 Twin Otter Series 400	4	2
Total	137	

NOTE: *19-seats and below, used on charters and scheduled services SOURCE: Flightglobal Fleets Analyzer



The N219 supports Jakarta's plan to gain a place at the top table of aerospace manufacturing nations



Dirgantara Indonesia held a roll-out ceremony for the new aircraft on 10 December 2015

Soedarmo admits the road ahead has challenges. A key hurdle for the N219 is a lack of skilled engineers, because after a previous government-led turboprop programme – the 68-seater N250 – was terminated in 1998 due to the Asian financial crisis, many skilled employees either quit IAe or retired. After this, Indonesia steered clear of major aircraft development programmes. Instead, it focused on being part of the supply chain for the leading OEMs.

Soedarmo says the N219 offers the opportunity to regain Indonesia's lost engineering skills, but that "this requires strong determination" from IAe as well as the Indonesian government. IAe will have to offer potential customers an acceptable financing package, and good aftersales support. Hardest of all, it will need to ensure reliability and low operating costs.

To date, the N219 has secured letters of intent from small and lesser-known carriers. These include Aviastar Mandiri, Nusantara Buana Air and charter operator Air Born.

While Lion Group has expressed interest to acquire up to 50 N219s, no firm expression or commitment to acquire the aircraft has been made. Lion had indicated to *Flight International* in August 2013 that should it proceed to buy the N219, it could use the type to add up to 200 additional airports to its network.

"These large air operators must carry out an internal feasibility study whether this new flight service using N219 aircraft would be profitable or not," Soedarmo adds.

BIGGER PLANS

Apart from the N219, IAe intends to develop a commercial variant of the CN235 military transport, designated the N245. It explains that by adopting the design, it will be able to optimise development costs and the time taken to build the N245.

Creating a commercial variant would involve re-designing the tail empennage to remove the ramp. This would also mean that creating an N245 therefore requires a series of alternate production stations parallel to the main line.

Besides re-designing the tail empennage, several frames would be added to lengthen

the fuselage. Changes to the design system as well as its interior are also being looked at.

One major change will be the engines. In a March 2015 interview with *Flight International*, IAe director of production Arie Wibowo said Pratt & Whitney Canada PW127s will power the N245, as opposed to the General Electric CT7s that power the CN235.

IAe sees the N245 operating at 25,000ft; higher than the typical ceiling of the CN235. The company feels the N245 would fill a niche between the developmental N219, which targets the segment served by the Twin Otter and Caravan, and the ATR series.

IAe's market analysis shows a domestic market for an aircraft with a capacity of 50 passengers that can operate from runways too short for ATRs.

At the start of 2016, IAe said it is still finalising the N245's design configuration, which will then be used in windtunnel tests. It hopes to have two to three prototypes ready for testing sometime in 2018.

In addition to its work on the N219 and N245, IAe produces wing structures for Airbus A320s, A350s and A380s, and provides maintenance, repair and overhaul related services. The company also is in-

"Aircraft manufacturing is a high risk, high capital business with low profit"

EDWIN SOEDARMO

Chief executive, CSE Aviation

involved with programmes such as the Airbus Helicopters H225, H332 and the Bell Helicopter 412.

The company is playing a junior role to South Korea's Korea Aerospace Industries for the KFX fighter programme. This was confirmed in January, with Indonesia to provide 20% of programme funding, which will see Indonesia receive 80 fighters and South Korea 120. This work on high-profile programmes makes clear that Indonesia, the world's fourth most populous country, wants a place at the top table of the world's aerospace industry, with IAe cast as an OEM.

"Aircraft manufacturing is a high risk, high capital business with low profit," says Soedarmo. "But [it] has a very significant benefit, through its spin-off effect to a nation. It [also] requires a large number of aircraft orders for the manufacturer to survive. At present, [it is largely] dependent on the government of Indonesia.

"Government [support] for IAe is initially required, before a rational step-by-step approach could be implemented to [turn] the company into a self-supporting company." ■





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ELLIS TAYLOR SINGAPORE

Singapore's Changi airport may be the premier passenger hub for Southeast Asia, but the smaller Seletar airport is staking its claim as the aerospace industry hub.

The historic airport – built for the Royal Air Force in 1928 – has grown from being in the shadow of Paya Lebar and Changi to be a major centre for business aviation, aerospace manufacturing and services, and maintenance, repair and overhaul (MRO). It is the key facility for the surrounding Seletar Aerospace Park (SAP), which houses most of those industries, and is the premier cluster for Singapore's growing aerospace industry. SAP was a joint initiative led by Singapore's Economic Development Board (EDB), and land developer JTC.

"The idea was to create an integrated and conducive environment for aerospace companies to operate and collaborate," Tan Kong Hwee, director of transport engineering at the EDB tells *Flight International*. "When companies invest in SAP, they are not just investing in land. They are plugging into an ecosystem and community." That ecosystem has a number of layers. The airport is largely used as an aviation facility, and hosts a range of business jets, as well as fixed-base operations and maintenance facilities from Jet Aviation, ExecuJet, Hawker Pacific and local firm MAJ Aviation.

The park is also a major aircraft and engine MRO centre. Fokker Services Asia has a facility supporting regional Fokker and ATR aircraft. Similarly, ST Aerospace has a major regional narrowbody MRO centre.

On the engines side, in May 2015 Vector Aerospace opened its first Asian MRO facility at Seletar, one of three worldwide designated for the overhaul of Pratt & Whitney Canada PW150A turboprop engines. Similarly, Safran's Turbomeca unit will open a new S\$50 million (\$34.8 million) facility for helicopter engine MRO this year.

"This is the first major investment by the French conglomerate at SAP and will add to the growing rotary-wing cluster that includes Airbus Helicopters and Bell Helicopter," says Tan. Supporting those operations are parts and support centres from the likes of Airbus's Satair unit, Bombardier and Embraer.

"The idea was to create an integrated and conducive environment"

TAN KONG HWE

Director of transport engineering, EDB

Training is another key focus of the park. ST Aerospace operates a growing flight training centre at Seletar, while Airbus Asia Training Centre – a joint venture between Singapore Airlines and Airbus – will soon open a 9,250m² facility there. That will house eight full flight simulators for the Airbus fleet. "This ensures Singapore is adequately prepared to cater to the increasing demand for training services," says Tan.

However, it is not just big name global players that are calling Seletar home, but also suppliers, such as UK company RLC Engineering, which opened a building in 2014 to supply

Rolls-Royce's wide chord fan blade manufacturing facility. Tan notes the park has benefited local companies, opening a route into the global supply chain for major players. "Looking to capture growth opportunities, local aerospace companies are looking to expand and SAP presents an attractive location."

He points to Wah Soon Engineering, a Singapore company that specialises in high-quality, complex tooling for engines, nacelles and airframes. Similarly, JEP Precision designs, fabricates and manufactures parts for Messier Bugatti-Dowty and UTC Aerospace.

ENGINE ROOM

While Seletar is home to many businesses, the production facilities of engine makers R-R and Pratt & Whitney play the most significant role. R-R has had a long relationship with Singapore, underpinned by the 1995 order by Singapore Airlines for Trent 800-powered Boeing 777-200s – at the time its biggest order. Attached to that was a deal to establish two engine overhaul joint ventures with SIA Engineering, under the Singapore Aircraft Engine Services (SAESL) brand.

"That started our thinking of what else we could look at in Singapore, and we engaged in workshops with the government of Singapore in the early 2000s to map out what the art of the possible might be for us," says Jonathan Asherson, R-R's regional director for ASEAN and the Pacific.

That led to R-R becoming a key tenant at SAP, and in 2012 it opened its 65,000m² campus there. "We have a 400-person hub with different businesses, support functions, technology centre, training centre and the two large [assembly] facilities," says Asherson.

Key to the facility, however, is the assembly and test centre for Trent 900 and 1000 engines, which power A380s and 787s, respectively. Full engine assembly is presently at 170 units

» per year, and will ramp up to 250 by the end of 2017.

Seletar will take a big step up soon, with R-R to use the facility as lead assembly shop for the Trent 7000, to power the A330neo. "It's because of the commonality of what we already do, so it makes sense using the people we have trained for the Trent 1000 to be able to do the 7000," says Bicky Bhangu, R-R's director of Singapore. However with capacity at Seletar limited to a maximum of 250 engines per year, some Trent 7000 production will also take place in Derby, the UK.

LOCAL EXPERTISE

R-R also operates a research and development centre at Seletar, which focuses on technologies for manufacturing wide-chord fan blades. Outside Seletar, R-R has partnerships with local universities and research institutes. It has also made Seletar an important arm in its global research and development. The research centre there is a global leader in computational engineering and is taking a leading role in electronic controls and power systems and precision manufacturing. Asherson adds, the company recently added key staff in Singapore with design authority, essentially allowing any engineering issues encountered in Asia, and requiring regulatory approval, to be handled locally.

P&W has also had a long association with Singapore and, ahead of the Singapore air show, will open its new manufacturing facility at Seletar. That shop will be used as a production centre for fan blades and turbine disks for its geared turbofans, such as the PW1100G offered on the A320neo.

Kevin Kirkpatrick, managing director of P&W's Singapore service centre, says "Singapore made sense", thanks to the strong legal and commercial infrastructure, while SAP also offered a chance to be part of a wider



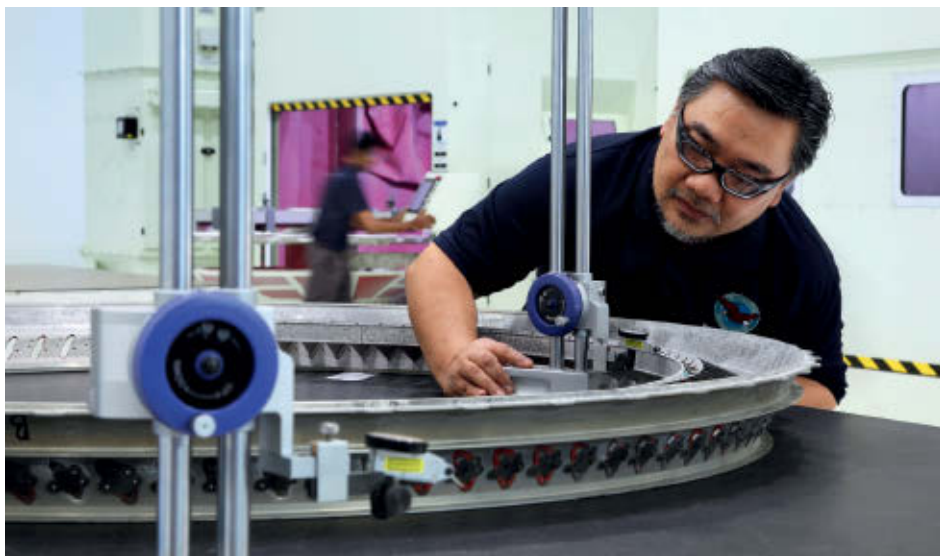
Rolls-Royce has an engine plant at Seletar

cluster. "As one of the major players here on the island, we obviously want to be a part of where aerospace is growing, and that is at Seletar," he says. "The EDB has specifically facilitated and encouraged Seletar, and we definitely wanted to be part of that."

Like R-R, P&W also has a joint venture with SIA Engineering, Eagle Services Asia, which is the only overhaul shop globally for the PW4000 series. It also services General Electric GE90-115B engines used on 777-300ERs and is able to do some repairs and services on Engine Alliance GP7000 engines used on A380s.

Although most of the tenants are now in place at SAP, there are further developments ahead. JTC plans to soon open buildings for companies requiring small and medium spaces. That follows the completion of "JTC Aviation Two @ SAP" in November last year, which caters to component overhaul and tooling manufacturing tenants.

Also on the drawing board could be the return of passenger services to the airport, albeit on nowhere near the scale of Changi. As the larger airport fills, the Singapore government intends to move turboprop operators across to Seletar. To facilitate that, a previous passenger terminal was demolished in 2014, and a new one is set to open in 2017. ■



Pratt & Whitney also has a big manufacturing presence at the increasingly important hub

AIRPORTS

Proud new arrivals

Plans for a new terminal at the popular facility include an emphasis on automation to reduce excessive document checks

FIRDAUS HASHIM SINGAPORE

When Singapore's Changi Airport announced plans for a fourth terminal in March 2012, to replace its six-year-old Budget Terminal, the response was mixed. The same sentiment lingers a year before Terminal 4 is set to open, in mid-2017.

Analysts question T4's effectiveness to complement Changi, especially with the lack of a monorail connecting it to the other three terminals. T4 will be connected via bus links on the air and land side. Infrastructure issues would make a monorail too expensive.

Shukor Yusof, founder of aviation advisory firm Endau Analytics, says bus links "do not do justice to the project and make T4 seem like a standalone terminal".

He questions Changi's ability to cope with just bus services when T4 reaches its estimated capacity of 16 million: "It will do Changi no favours when passengers start to complain. It is better to put in all the bells and whistles now."

On the lack of a monorail, Changi says: "With the [aircraft] bridges spanning Airport Boulevard and services underground along Airport Boulevard, it will be extremely challenging technically to build tracks either above ground or underground for a Skytrain connection between T4 and the existing terminals."

SEAMLESS TRANSFERS

Timothy Ross, head of transport research for Asia Pacific at Credit Suisse, believes T4 will be launched with a disadvantage, but is confident Changi "will be able to make the necessary adjustments to make transfers seamless".

Ross believes there could be a reason for T4's infrastructure differences compared to the other terminals: "As it is, regional low-cost carriers and legacy carriers operating [at T4] have little or no need to move passengers between terminals. Singapore is the final stop."

Even Singapore's senior minister of state for transport, Josephine Teo, acknowledges: "The new scale of Changi requires [all stakeholders] to think differently." In a recent speech, she stressed the importance of lessons from experiences. "One is that good infrastructure is essential, and it is hard to modify infrastructure once a design has been pinned down. That is why we are careful not to rush the design process."



Changi airport

Changi's T3 is linked by monorail to T1 and T2, but planned reliance on a bus service for T4 has raised concerns

However, Changi's senior vice-president of market development, Lim Ching Kiat, defends the airport's decision, saying the lack of a monorail will not impact T4's service. "Our bus links will make it on par with the other terminals. We hold passenger service dear as one of our major priorities and will endeavour to make a smooth transport process."

Changi's three other terminals are running at 80% of a design capacity of 66 million passenger movements annually, so Lim sees T4's timing as "very opportune". Credit Suisse's Ross notes that once an airport reaches 70% of capacity, it needs to start building new terminals. "T4, as with the upcoming T5, is Changi's way of 'futureproofing' Singapore. They are building assets with a long shelf-life to ensure high usage rates in the time ahead."

"For Changi to stay successful and be ahead of its competition, it has to keep building ahead of demand – Changi can never be full."

Endau Analytics' Yusof has confidence in the government's planning, with Changi as a focus of growth. "[Singapore] does not look at growth in 10 to 20 years but instead, at least, for the next 35 to 50 years."

With the Southeast Asian population set to grow by around 605 million by 2020, coupled with a surge in the middle class, the construction of T4 and T5 seem prescient.

EXPANDING NETWORK

Lim says Changi is aware of the booming aviation industry in neighbouring countries and is mindful of ever-increasing competition. However, he adds one way Changi is staying ahead is by expanding its network to Tier 2 and Tier 3 destinations, while expanding its core markets.

"No two airports have the same catchment area. We intend to capture the Intra-Asia Pacific traffic by punching deeper into large countries like China and India."

He cites pending and recent connections to Fiji (via Fiji Airways in April 2016) and Uzbekistan (via Uzbekistan Airways in April 2014) as examples of Changi's expansion into other destinations. "We are simply planting seeds for tomorrow – we may not see high yield today, but they might achieve it one day."

Six airlines – Cathay Pacific, AirAsia, Indonesia AirAsia, Thai AirAsia, Korean Air and Vietnam Airlines – will operate out of T4, which has 21 contact stands: 17 for narrow-body aircraft and four for widebodies. According to Changi, these carriers operate 800 flights

weekly and account for seven million passenger movements. Between eight and 10 million passenger movements are expected in the first year. "With more than 50% of design remaining, T4 airlines riding on the rapid growth in the region will have abundant headroom to expand," says a spokesperson. T4 airlines will link the airport with 19 destinations, mainly in Southeast Asia and East Asia.

When Singapore's former Budget Terminal closed in September 2012, it had a capacity of seven million and had handled 4.6 million passengers in 2011. Operators using the terminal were Tigerair, Firefly, Cebu Pacific and Malaysian charter carriers Berjaya Air and Cebu predecessor SEair. The Budget Terminal was a far cry from the other three, with their elabo-



Changi airport

T4 will be a testbed for automated operations, including all-self-service check-in

» rate design features, such as a butterfly garden, movie theatre, and swimming pool – not to mention high-end shops. It featured basic food and shopping options. Lacking aerobridges, passengers were obliged to walk across the tarmac to board, rain or shine, but it was simple and efficient and popular.

LESSONS LEARNT

“The Budget Terminal was not a mistake,” says Lim. “But Changi has taken the lessons learnt and implemented them in the construction of T4, which represents a window of opportunity to add more capacity via an infrastructure aligned with the rest of the airport.”

He adds, T4 will have the same landing charges and user fees as T1, T2 and T3. When asked about landing charges for the T5 project, Lim declines to comment.

With half of T4’s carriers low-cost operations (AirAsia, Thai AirAsia and Indonesia AirAsia), Lim says Changi has acknowledged “many of [its] new links are brought about from LCCs [low-cost carriers]” and their task “is to keep costs low to grow new routes, not just for them but also for full-service carriers that enhance [their] long-haul connectivity.”

Lim tells *Flight International* that in light of manpower constraints T4 will be a “testbed for new technology and processes” that may be rolled out across Changi. One such example is automation. T4 will be the airport’s first all-self-service check-in terminal.

This is a major change. Changi’s existing three terminals are manpower intensive. It is impossible, for example, to print a boarding pass at home, and passengers who use the airport’s check-in kiosks must still have their documents checked by an airline staffer before immigration.

At present, automated passport scanning machines reconcile passports with passenger’s thumbprints, but passports and boarding passes need to be again checked by a security guard – this despite a passport/boarding pass check

before the immigration area. The existing terminals’ practice of screening passengers only when they reach the gate also generates demand for security personnel – although T4 will reconcile this with central security.

As systems stand, departing passengers’ documents are checked six times at Changi, from check-in to boarding. T4 automation plans suggest that Singapore’s leadership, with its emphasis on improving local productivity, is eager to change this.

Another aspect of T1 and T2 that infuriates some arrivals are post-flight security checks for flights chosen at random, which scrutinise Singapore residents returning home and transit passengers alike. The checks are manpower intensive and deeply unpopular.

“Singapore’s resident workforce growth has slowed and may level off in a few years. This means Changi’s workforce cannot simply be doubled to match capacity expansion. Changi’s future operations must therefore not be business as usual on the manpower front. We will have to fundamentally rethink how we harness the enthusiasm and abilities of our people so they can be highly skilful and enable a highly productive work environment in the entire aviation sector,” says senior minister Teo.

Changi also looks for ASEAN open skies to give it a boost, although a single aviation market for the region is elusive, owing to domestic resistance in key markets like Indonesia and the Philippines. “There are few routes that airlines want to fly to, but are prevented. That said, more liberalisation at other airports definitely benefits us,” adds Lim. In turn, Changi is working with authorities to encourage liberalisation of some countries’ visa requirements.

In the near term, Changi intends to help key regional airline partners exploit low oil prices to improve their networks. “We are seeing more appetite for risk from airlines lately to fly to new, further destinations. And we expect to be in a good position in the next one to two years.” ■

POLICIES

Lacking agreement

Members of the Association of Southeast Asian Nations have yet to reach a deal to create an open skies market across the region

MAVIS TOH SINGAPORE

ASEAN is some distance away from achieving a truly single aviation market, with three member states yet to fully ratify multilateral air service agreements by the 2015 year-end deadline. Agreements were supposed to be in place for airlines from the 10 member states to operate freely from their home country to any city within the bloc by 2015. Indonesia, the Philippines and Laos however, have yet to ratify a deal.

While Indonesia has only opened up Jakarta, the Philippines is barring Manila from the pact, and Laos has yet to open up Vientiane and Luang Prabang.

“The problem of ASEAN is it’s not a top down organisation but built on consensus”

ANDREW HERDMAN

Director general, Association of Asia Pacific Airlines

Wolfgang Sander-Fischer, air transport expert for the ASEAN Air Transport Integration Project, says that aside from the missing ratifications, accompanying harmonised economic and market law agreements are also yet to be agreed by all 10 member states.

“The problem with ASEAN is that it’s not a top down organisation but built on consensus, so the pace of implementation varies and you’ve got some countries which are slower than others,” says Andrew Herdman, director general of the Association of Asia Pacific Airlines.

SAFETY CONCERNS

Another issue is that several of the countries, such as Indonesia and Thailand, fail to fully meet either ICAO standards or the audit requirements of the USA and the EU. These shortcomings could hamper the further development of the open skies framework, Sander-Fischer believes.

Seventh freedom and domestic operations by foreign carriers have also yet to be contemplated. These rights will allow airlines to establish bases outside of their



The airport hopes liberalisation of ASEAN air travel markets will boost passenger numbers

home country without requiring 51% to be under local ownership.

The concern for some countries is that their airlines will not be able to compete effectively with stronger rivals, and hence will lose market share. With an uneven level of development and competitiveness among member states and airlines, some carriers believe they have more to lose than to gain.

Aviation law professor Alan Tan says member states need a united stand to avoid losing out in negotiations with other countries and blocs. An example is the ASEAN-China bilateral agreement, which allows Chinese carriers to connect with all points in ASEAN, while an ASEAN carrier can only penetrate Chinese points from its home country. "This presents a serious network imbalance that can only be rectified by the ASEAN states treating their own backyard as a true common market," he adds.

CONGESTION ISSUES

Herdman is of the view that the slow liberalisation of traffic rights does not constrain growth of the region's air travel demand, although it may affect who gets to serve that demand. What is more concerning, he says, is the congestion at the region's

BIGGEST INTRA-ASEAN MARKETS

Country pair	Seats	Flights
Indonesia-Singapore	451,456	2,235
Indonesia-Malaysia	420,734	2,459
Singapore-Malaysia	366,311	2,281
Thailand-Singapore	321,779	1,526
Malaysia-Thailand	246,706	1,413
Thailand-Vietnam	152,259	726
Singapore-Philippines	149,793	703
Myanmar-Thailand	116,091	678
Singapore-Vietnam	114,573	576
Thailand-Cambodia	85,846	581

NOTE: January 2016; SOURCE: Innovata

hubs – both in terms of infrastructure and air traffic management.

Some of region's airports, including Bangkok's Suvarnabhumi International and Jakarta's Soekarno-Hatta International, have for years been operating at above their original design capacity.

Data from ASEAN shows that annual capacity on intra-ASEAN arrivals has increased steadily over the years, from 37.4 million in 2007 to 46.8 million in 2010 and 69.6 million in 2014. Achieving open skies will only drive the figure higher.

Happy to be here, but still dreaming of open skies



Xinhua News Agency/REX/Shutterstock

"Only regionally harmonised approaches to airport development and utilisation, as well as to air traffic management, will yield best utilisation of airport, airspace and other resources," says Sander-Fischer.

"Only an ASEAN-wide economic playing field will allow unimpeded competition among carriers of all member states, bringing out full benefits for consumers."

Data from Flightglobal's schedules specialist Innovata shows more than 34,000 intra-ASEAN flights in January, led by flights from Singapore and Malaysia. ■

Advancing the open skies pact will help Asian carriers keep pace with fast-rising demand



Aircus

From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

Battle royal to save Hovercraft

A campaign has been launched to save one of the last two cross-Channel Hovercraft from being scrapped.

The SRN4s – *Princess Margaret* and *Princess Anne* – have resided at the Solent's Hovercraft Museum since being decommissioned in 2000, but their owner, the museum's landlord, is selling them as land next to the site is developed.

The icons of the 60s and 70s – built by the British Hovercraft Corporation on the Isle of Wight and which featured regularly in *Flight International*, including as a cutaway – are the last of the 250t giants that carried 400 passengers and 55 cars between Dover and France in trips of around 30min.

The craft face destruction unless funds can be raised to save them for the nation, says museum trustee Emma Pullen.

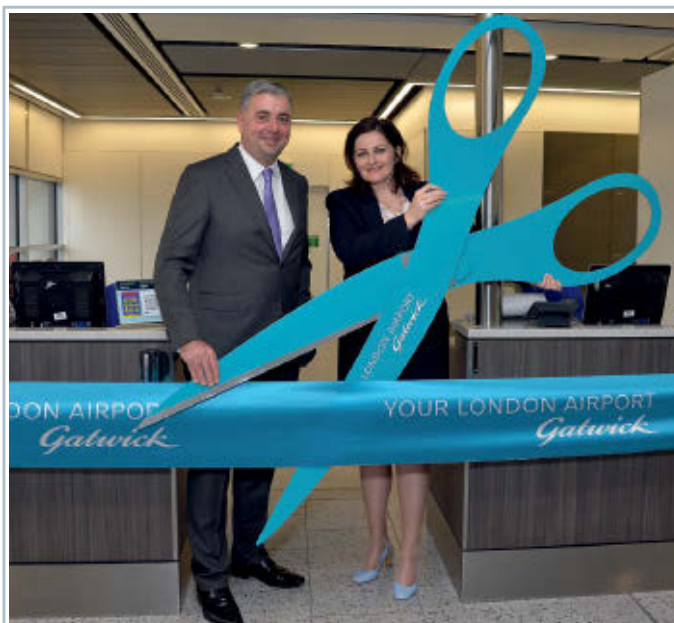
"The SRN4s are our most important exhibits," she says. "Many people come simply to see these huge relics of a bygone age and their loss would be an enormous blow to the museum. But more importantly, they are a piece of British history, the like of which we will not see again."

Although *Princess Margaret* is likely to be broken up for scrap, trustees have submitted a proposal to the site owner to save *Princess Anne*, which is in a better condition.

A petition on the museum's Facebook page and web site is attracting many signatures.



Spot of bover: help save *Princess Anne* from the scrapyard



"I don't care if you are a member of parliament, madam, you can't take sharps through security."
(Gatwick chief executive Stewart Wingate helps Caroline Ansell MP cut the ribbon on the airport's renovated Pier 5)

Bird strike

A list of the compensation payments that the UK Ministry of Defence made in 2014/15 to individuals who complained about the effects of low-flying aircraft – and which has been published under the Freedom of Information Act – contains some fascinating details.

Alongside entries such as £90 for "downdraft damage to a tent" caused by a Sea King, and £1,396 for an injured cow blamed on an Apache, a complainant in Derbyshire received almost £13,400 for "loss of birds of prey". The guilty aircraft? A Hawk.

A mystic, surely

The latest newsletter from US industry lobby group the Aerospace Industries Association is headed "Key successes for AIA in 2016". Now that's what we call confidence in the future.

Delta belters

An air rage incident prompted the captain of a Delta 757-200 to make an emergency landing. But it was not a passenger that was doing the raging – it was cabin crew.

A row between two female attendants 40min into the flight from Los Angeles to Minneapolis led to punches being thrown and a third crew member being hit in the face.

The captain requested a diversion to Salt Lake City, where the three employees were ordered off the aircraft. The 757 was grounded for 80min before resuming its journey after new cabin crew were found.

It is not clear if the warring individuals resolved their differences. Maybe their fight was simply delayed.

Crossed wireless

"In the German Wireless message to-day the *Kolnische*

100 YEARS AGO

Zeitung reports from the Dutch frontier that on the recent air raid

to this country His Majesty's ship 'Caroline' was struck by a bomb, in the Humber, and sunk, with great loss of life. "Neither His Majesty's ship 'Caroline' nor any other of His Majesty's ships, nor any merchant ship, was struck by a bomb, in the Humber, nor in any other port."

African advance

Sir Archibald Wavell is striking out vigorously on four fronts,

75 YEARS AGO

Libya, Eritrea, Abyssinia, and Somaliland, and everywhere is

pressing the retreating Italians hard. British troops have stormed Derna after a three-days' fight.

Carried away

There is no doubt the Whitehall battle between the

50 YEARS AGO

air marshals and admirals over the defence review has been won by

the air marshals, who gained every major point including a policy decision to run down the carrier force.

American retreat

McDonnell Douglas (MDC), Hughes Aircraft and Raytheon

25 YEARS AGO

have decided not to attend this year's Paris air show, marking the

start of what may become a major reduction in the US presence at Le Bourget, prompted by security fears and economic pressures.

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Refuelling the capacity debate

In your article 'SDSR fuels rotorcraft study' (*Flight International*, 26 January-1 February) you quote Maj Gen Richard Felton, commander of the UK's Joint Helicopter Command, saying that in order to provide an air refuelling capability for modified long-range helicopters, "we might go down the route of [equipping] the aircraft, but not buy the tankers because we can use another nation's".

In the same report you also quote from the latest Strategic Defence and Security Review (SDSR) that the UK would "upgrade helicopters and transport aircraft so we can deploy further, faster and independently, to meet threats around the world". How can it do this independently if it has to rely on others for aerial tanking?

The answer is staring everyone in the face. The RAF operates 23 Lockheed Martin C-130J Hercules, many of which are due to be disposed of, leaving 14 to be upgraded to serve into the next decade. Why not equip some with air-to-air refuelling

SAFETY

Give flightcrew complete control

I read with interest James Bowyer's letter discussing how the lack of piloting skills resulted in the loss of AirAsia flight QZ8501 in 2014 and Air France flight AF447 in 2009 (*Flight International*, 12-18 January) and I agree entirely.

The incident report into QZ8501 notes the initial flight-deck manifestation was a rudder hard over, requiring immediate corrective action by the crew. What was not noted in Bowyer's letter, was that the original problem with the rudder was not indicated by a corresponding movement of the rudder pedals, so the crew had reduced information concerning the positions of their flying control surfaces.

Those of us who follow these events know full-well that flightcrew have to carry the burden of trying to recover from an upset condition without all the information being available to them. The lack of information comes from there being no control surface feedback. In this case, the rudder hard over occurred without any corresponding movement of the pilot's controls. We all know the recurring defect on the AirAsia Airbus A320 should have been rectified prior to this flight, but this opens up another can of worms.

David Sidgwick

Peterborough, Cambridgeshire, UK



Wreckage of flight QZ8501

Xinhua/REX/Shutterstock

equipment, as was done during the Falklands War? This would provide a perfect solution.

Richard Gardner

Farnborough, Hampshire, UK

Back to black?

Anthony Atkinson's letter (*Flight International*, 26 January-1 February) suggesting that DayGlo fluorescent paint would have made the civil glider involved in the airprox on 16 July 2015 above Pateley Bridge, North Yorkshire, UK more apparent to the Royal Air Force BAE Systems Hawk T1, is possibly only a partial solution.

The RAF Air Training Corps

Viking and Vigilant fleets do use a scheme with liberal amounts of DayGlo, but several years ago, after a run of mid-air collisions and near-misses, the RAF decided that plain, simple black – albeit coupled with high-intensity beacons – was the best way of making training aircraft conspicuous when viewed against typical backgrounds.

The bright red and white schemes of old largely disappeared from the fixed- and rotary-winged trainers. The Scottish Aviation Bulldog was receiving the black scheme at the time of withdrawal, but its replacement – in the combined fleet of the University Air Squadron and Air

Experience Flight – is owned and operated by a civilian contractor and not bound to that policy (or someone omitted to specify that in the tender documents). As it survived the upheaval, I'm assuming the white and DayGlo glider scheme does have some advantages in a fairly close, relatively densely occupied circuit, such as around an airfield where winch launches and short training flights are the norm.

But how much would that help fast jet traffic see and avoid cross-country/performance glider flights, as appears to have been the case here?

Mike Tighe

London, UK

Freight weight boosts income

Reading your interesting feature "True cost of flying" (*Flight International*, 12-18 January), I note the article does not take into consideration the lower-deck cargo transport on passenger airliners.

Lower-deck cargo is a relevant source of income, especially for the global-network carriers sitting at the bottom of the fuel efficiency list. A low-density passenger configuration is normally balanced, from a payload perspective, by a robust cargo figure.

The lower-deck cargo can range from 15t on a long-range passenger Boeing 747-400 to over 20t on a 777.

In 2014, American Airlines announced it had carried 50t of cargo in addition to the average passenger payload on a Los Angeles-London flight using a 777-300ER. This figure cannot be left out of this analysis.

Marco Pacagnella

via email



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Grand Hyatt, New York

iata.org/events/pages/aviation-day-usa.

aspx

29 February

Loyalty 2016

Bangkok, Thailand

flightglobalevents.com/loyalty2016

1-3 March

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WORK EXPERIENCE KATHERINE WALLACE

Determined to fly following 9/11

Years of training and quality flying experience couldn't prevent Katherine Wallace from being furloughed after the 11 September 2001 terrorist attacks, but her persistence has been rewarded as a Southwest 737 captain

What are your current duties?

I am a Boeing 737 captain, and I also work with our pilot recruiting team, doing outreach events and pilot interviews. Typically I arrive at my base one hour before my first scheduled flight. At the gate I supervise the preparation of the aircraft and ensure it is safe for the flights we have planned that day. During a typical day's flying I will fly half the legs and act as monitoring pilot on the legs my first officer is flying.

Where did you start out?

I attended high school in New Zealand and completed my college degree via distance learning. It took me about eight years of part-time study to finish a four-year degree, but I got it done. I was concurrently flight instructing and flying for a regional airline whilst completing the degree. My flight training was done in a compressed course that went from private to certified instrument flight instructor in about a year. I got most of my ratings in Tennessee, then moved to Southern California, where a friend helped me get a job at Van Nuys airport. Unbeknownst to me it was the busiest general aviation airport in the US. Needless to say, it was a steep learning curve, but a wonderful airport to base and work out of.

And then you took off?

With my air transport pilots licence and about 2,000 flying hours under my belt, I was able to obtain my first regional airline job, where I flew as a first officer



Wallace worked up via regional, legacy, supplemental and major operators

and captain on a Beech 1900, then as captain and check airman on a Bombardier Dash 8. I then worked for three other carriers before landing at Southwest Airlines. After obtaining a lot of Part 135 [charter] and 121 [scheduled commercial] experience, I moved on to a major airline job, where I was initially training as a flight engineer. When 9/11 struck I was quickly furloughed. Getting back into the industry a few years later was very difficult, but I had re-evaluated my desires and had my sights set on Southwest. Although my qualifications were competitive, I was not current, so I obtained a 737 type rating, and then worked for two other airlines before I became competitive enough to be called for an inter-

“Although piloting a plane is a pretty cool job, it's the people that make it into a great job”

view. So I have flown for a regional, legacy, supplemental, major, and now Southwest. We currently operate four 737 variants – the -300, 500, 700 and 800.

What do you enjoy most?

The people I get to work with. Although piloting a plane is a pretty cool job, it's the people that make it a great job. The other pilots, along with our flight attendants, operations, station and corporate personnel, are a

phenomenal bunch of professionals. I am always amazed at what a dependable and capable group my co-workers are.

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